The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

APRIL, 1928 VOL. 13, No. 4

$3.00 per year in U. S. 506 S. Dearborn St., Chicago, Ill. $4.00 per year abroad

BUCKEYE OXYGEN COMPANY

CANTON, OHIO

PURE OXYGEN

AND

"EVERYTHING FOR THE WELDER AND CUTTER"

American Oxygen Service Company

New York City

Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill. Under the Act of March 3, 1897.

The Gauge *that welders prefer...*

For many years past the largest manufacturers in the industry have found Natweld Gauges universally satisfactory in use.

Further than this Natweld Gauges are approved by the Underwriters' Laboratories. These gauges have, therefore, been thoroughly tested in two ways: under actual working conditions by their many users and in the Laboratory by the Underwriters. The result of both tests has been unqualified acceptance of Natweld.

This company manufactures a very complete line of gauges for all welding uses, and maintains an experienced staff of engineers to advise gauge users on the proper type of instruments for their equipment.

Your inquiries will receive prompt attention.

NATWELD

The Moto-Meter Co. of Can., Ltd.
Hamilton, Ontario
Chicago Office: 820 Tower Ct.

NATIONAL GAUGE & EQUIPMENT CO.
La Crosse, Wisconsin
Division of The Moto-Meter Company, Inc., L. I. City, N. Y.

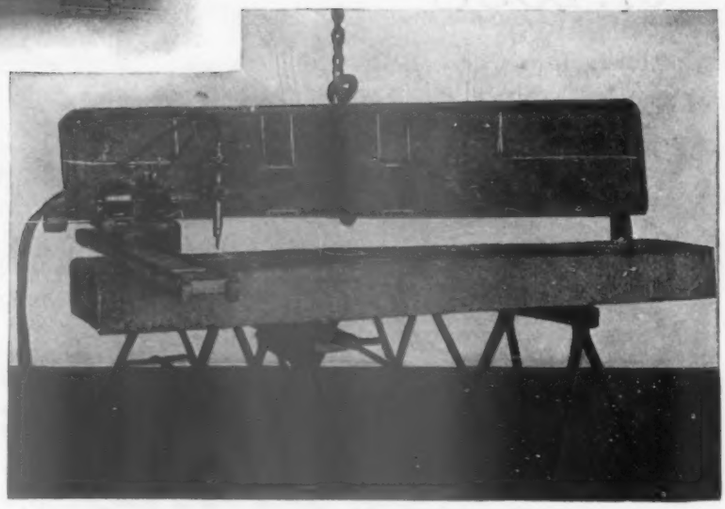
Represented in Illinois, Indiana, Wisconsin, Minnesota, Missouri
By Joseph Halla, Chicago, Illinois
333 North Michigan Avenue.

THIS TAG IS ON EVERY
AIRCO OXYGEN CYLINDER

Buy
Your Oxygen On
Specification for Purity

AIRCO OXYGEN IS 99.5%
PURE IN THE CYLINDER

The Purest Oxygen Is
Always the Most
Economical



For Accurate, More Economical Straight Line and Circular Cutting—

The Airco-Davis-Bournonville Radiagraph

For steel foundries, fabricating plants, bridge works, boiler shops, shipyards and all places where plates, structural shapes, billets, blooms, forgings, and steel castings are shaped and trimmed—this portable motor-driven machine reduces the cost of cutting at maximum speed and produces accurate cuts at any angle.

The Radiagraph travels on light grooved track for straight line cutting and has a radius bar and pivot point for circular cuts. The cutting torch is mounted on a cross-slide operated by a handwheel, providing for short lateral and offset cuts.

A word to the nearest District Office listed below will bring you further information—without obligation of course.

AIR REDUCTION SALES COMPANY

Manufacturers and distributors of Airco Oxygen, Airco Acetylene, Airco National Carbide, Airco - Davis - Bournonville Welding and Cutting Apparatus and Welding Supplies

110 Distributing Points

Baltimore	Cleveland		Los Angeles	Pittsburgh
Birmingham	Dayton		Milwaukee	Richmond
Boston	Detroit		Minneapolis	Seattle
Buffalo	Emeryville, Calif.		Oklahoma City	St. Louis
Charlotte, N. C.	Jersey City		Philadelphia	Wheeling
Chicago				

65 Plants *Home Office*—342 Madison Avenue, New York City, N. Y. 21 District Offices

"RACO" RED LABEL ROD

was used exclusively for welding the steel construction

in the Ryan plane

"THE SPIRIT OF ST. LOUIS"

B. F. MAHONEY AIRCRAFT CORP.
SAN DIEGO, CALIFORNIA

FEBRUARY 15 1928

Reid-Avery Company,
21st & Washington Ave.,
Philadelphia, Pa.

Gentlemen:

Subject: Red Label Welding Rod.

We have been using Red Label welding rod supplied by you for the past year and a half in the construction of our Ryan monoplanes. This rod is used for welding up steel tubing in the fuselage frame, ailerons, tail surfaces and landing gear.

This rod was used exclusively for welding the steel construction in the Ryan plane "the Spirit of St. Louis" which we built for Colonel Lindbergh, and in which he has since flown many thousands of miles with no report of failure in any welded joint.

We take pleasure in stating that your rod has been checked against a number of different makes and has proved to be the best suited for the particular kind of work which we are doing.

Very truly yours,
B. F. MAHONEY AIRCRAFT CORPORATION
(Owners of Ryan Airlines)
Walter O. Locke
Walter O. Locke
Production Engineer

WOL:C

Manufacturers of

- OXY-ACETYLENE WELDING RODS
- ELECTRIC WELDING RODS
- "RACO" COMPOSITE WIRE FOR AUTOMATIC ELECTRIC ARC WELDING

America's Standard

REID-AVERY CO., *Inc.*, PHILADELPHIA

The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 13 | April 1928 | Number 4

CONTENTS

Expanding the Heating Plant 29
By A. W. Birnie

Wanted—A Steel Weldery 32
By Hyman Levine

Resistance Welding Aids Redesign 37

Training Men for Gas Welding 41
By M. C. Stone

Practical Studies of Electrodes 43
By K. R. Hare

Editorial 27

Program of Annual Meeting of American Welding Society 35

Unearth Ferrule Welded in Fourth Century A. D. 36

Manufacturers' Exhibits at Welding Conferences 40

Forty-Five-Mile Gas Line Arc Welded 42

Welding in Mexico 46

Overcoming Arc Blow 47

General Electric Welds Building 48

Arc Welding New Type of Oil Tank Roof 49

News of the Welding Trade 52

The Progress of Industry

INDUSTRIAL accomplishments are so important in modern times that no man can afford to be content with knowledge of old methods. Familiarity with the new processes and the new tools of industry helps the executive to keep up with his competitors and often to get ahead of them. Herein lies the value of trade and technical papers to busy executives and engineers. The advertising section presents a graphic picture of new equipment and new materials, with their possibilities explained in the clearest and briefest terms. Each new message is the solution of an old problem. The firms behind these announcements are the builders of industrial progress, taking this modern way to keep the world informed of the steady march toward greater efficiency.

Published on the 15th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,
608 S. Dearborn St., Chicago, Ill.
Telephone Wabash 7134

G. H. Mackenzie.....President and Treasurer
H. S. Card.....Secretary

H. S. Card.....Editor
H. P. Ritsch.....Associate Editor

Eastern Office—222 American Circle Bldg., New York. T. E. DePew, Eastern Manager. Telephone, Columbus 6941

Western Office—1244 Harper Ave., Los Angeles, Cal. Miles C. Smith, Western Manager.

Subscription payable in advance and postage free.
United States and possessions and Canada.....$3 a year
Foreign Countries.....$4 a year
Single copy, domestic.....25 cents
Single copy, foreign.....30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 13th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 13th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

Authorized Representatives

CLEVELAND—R. K. Randall, 3094 E. 19th St.
DENVER—A. G. Odell, Public Opportunity School.
GREAT BRITAIN—Capt. D. Richardson, 26 Winterbrook Road, Herne Hill, London.
AUSTRALIA AND NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand.
SOUTH AFRICA—J. W. Arnison, 35a Victoria Ave., Benoni, Transvaal, South Africa.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
International Oxygen Co.
Prest-O-Lite Co.

ACETYLENE CYLINDERS
Keith Dunham Company
Pressed Steel Tank Co.

AIR LIQUEFACTION OXYGEN PRODUCING PLANTS
Keith Dunham Company
Heylandt Sales Co.

ALUMINO-THERMIC WELDING
Metal & Thermit Corporation

ALUMINUM SOLDER
Crown Aluminum Solder Co.
Miller Aluminum Solder Co.
Weldene Corporation

ANNEALING FURNACES
General Electric Co.
Westinghouse Elec. & Mfg. Co.

APRONS (Asbestos)
Ideal Face Shield Co.

ASBESTOS INSULATED WIRE AND CABLE
Central Steel & Wire Co.

BLOW PIPES
See "Torches."

BOOKS
The Welding Engineer Pub. Co.
Electric Arc Cutting & Welding Co.

BRAZING OUTFITS
Air Reduction Sales Co.
American Oxygen Service Co.
Bastian-Blessing Co.
Buckeye Oxygen Co.
Craftsweld Equipment Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
Williams & Co.

BRONZE FILLER RODS
American Brass Co.
Central Steel & Wire Co.
Krembs & Co.
Mueller Brass Co.
Steel Sales Corp.

BUFFERS
Biax Flexible Shaft Co.
R. G. Haskins Co.
N. A. Strand & Co.

BUTT WELDERS
See "Electric Resistance Welders"

CABLE (Arc Welding)
Allan Mfg. & Welding Co.
Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Lincoln Electric Co.
Quasi-Arc Weldtrode Co.
Una Welding and Bonding Co.
U. S. L. Battery Corp.
Westinghouse Elec. & Mfg. Co
Wilson Welder & Metals Co.

CARBIDE
Air Reduction Sales Co.
National Carbide Co.
Shawinigan Products Corp.
Union Carbide Sales Co.

CARBON (Blocks, Paste, Electrodes, etc.)
Air Reduction Sales Co.
Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
National Carbon Co.
Oxweld Acetylene Co.

CARBON BURNING EQUIPMENT
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.

CAST IRON SOLDER
Crown Aluminum Solder Co.
Weldene Corporation

CONSULTING ENGINEER
E. F. Hollinger
R. E. Kinkead
R. C. Pierce

CONTRACT WELDERS
S. O. S. Welding Corp.

CUTTING ELECTRODES (Electric Arc)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Lincoln Electric Co.
National Carbon Co.
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CYLINDERS (Acetylene)
Keith Dunham Company
Pressed Steel Tank Co.

CYLINDERS (Oxygen, Hydrogen)
Wm. Wharton, Jr. Co.

DRILLS, PORTABLE ELECTRIC
Biax Flexible Shaft Co.
R. G. Haskins Co.
Stoody Company
N. A. Strand & Co.

ELECTRIC ARC WELDING OUTFITS
Allan Mfg. & Welding Co.
Burke Electric Co.
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
Electric Welding Machine Co.
Fusion Welding Corporation
General Electric Co.
Goodman Electric Machinery Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Lincoln Electric Co.
E. A. Lundy Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Stoody Co.
Una Welding and Bonding Co.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRIC RESISTANCE WELDERS
Federal Machine & Welder Co.
General Electric Co.
Gibb Welding Machines Co.
Goodman Electric Machinery Co.
R. D. Thomas Co.

ELECTRODES (Carbon Arc Welding)
See "Cutting Electrodes"

ELECTRODES (Metallic Arc Welding)
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corporation
Koro Corporation
Lincoln Electric Co.
Page Steel & Wire Co.
Quasi-Arc Incorporated
Reid-Avery Co.
Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
Standard Steel & Wire Co.
Steel Sales Corp.
Stoody Company
Una Welding and Bonding Co.
Waters Arc Welding Corp.
Welding Service Co.
Wickwire Spencer Steel Corp.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRODE HOLDERS
Allan Mfg. & Welding Co.
Burke Electric Co.
Chicago Steel & Wire Co.
Electric Welding Machine Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Koro Corporation.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Una Welding and Bonding Co.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRODE TIPS (Resistance Welding)
Elkon Works, Inc.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
International Oxygen Co.

FACE SHIELDS (Arc Welding)
Allan Mfg. Co. & Welding Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Stoody Company
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.
Willson Goggles, Inc.

FILLER RODS
Air Reduction Sales Co.
American Brass Co.
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Craftsweld Equipment Co.
Fusion Welding Corporation
C. H. Hollup Corp.
Imperial Brass Mfg. Co.
Krembs & Co.
Mueller Brass Co.
Koro Corporation
Oxweld Acetylene Co.
Page Steel & Wire Co.
Reid-Avery Co.
Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
St. Paul Welding & Mfg. Co.
Standard Steel & Wire Co.
Steel Sales Corp.
Stoody Co.
Stulz-Sickles Co.
Torchweld Equipment Co.
Welding Service Co.
Wickwire Spencer Steel Corp.
Weldit Acetylene Co.
Williams & Co.

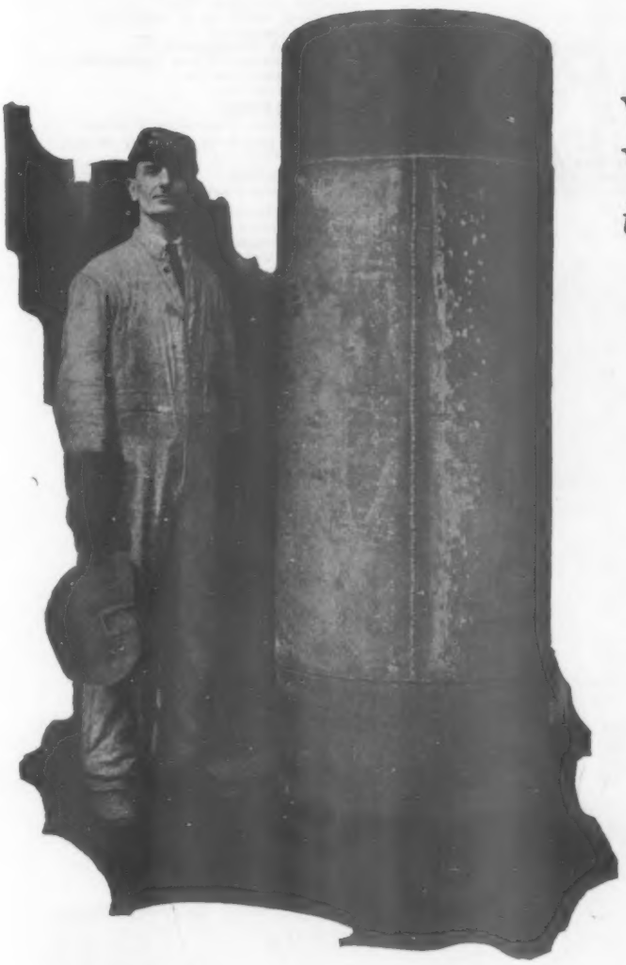
FIREPROOF PLASTIC MATERIAL
Air Reduction Sales Co.
Joseph Dixon Crucible Co.
National Carbon Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
Anti-Borax Compound Co.
Metal & Thermit Corp.
Central Steel & Wire Co.
Krembs & Co.
Modern Engineering Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Torchweld Equipment Co.
Weldene Corporation
Weldit Acetylene Co.

GAS SAVING DEVICES
Harris-Calorific Co.
Weldit Acetylene Co.

Only WELDING could meet this EMERGENCY



Vacuum Reservoirs Electrically Welded with WILSON WIRE *in average time of 3 hours each*

AT the works of G. D. Peters & Co. Ltd., Slough, England, came a rush call for a battery of *vacuum reservoirs*. It was necessary that they be made from material on hand as immediate delivery was imperative.

Deep-pressed ends were used as heads. ⅛" steel plates were curved to the same diameter to form the bodies. All edges were welded with Wilson Grade No. 6* Welding Wire.

In an average time of 3 hours each these cylinders were welded into air-tight reservoirs to withstand 45 lbs. compressed air pressure per square inch. The total seam length per reservoir was 18½ feet. Only welding could meet this emergency. Riveting was out of the question.

*Pat. U. S. A. June 13, 1916 (two patents) and March 9, 1920; Canada, March 19, 1918.

* * * * *

Why not let Wilson Wire demonstrate for *you* its *uniformity*, its *smooth flowing* quality, its *economy*? There is just the *right* grade (analysis) of Wilson "Color-tipt" Welding Wire for each kind of metal, and every grade runs *uniform throughout* —every rod is exactly like every other rod of the same grade. Use Wilson Wire—the right grade for the job—and "the rest is up to the welder".

Above is shown one of the vacuum reservoirs welded by G. D. Peters & Co. Ltd., of Slough, England, referred to in this advertisement. Wilson "Color-tipt" Grade No. 6 was used.

Wilson Model S, One-Operator Motor-Driven Machine

Whatever the industry, there is the *right grade* of Wilson Wire for the particular metal *you* are welding. And there is a Wilson Model S Welding Machine that will exactly meet *your* particular welding requirements and operating conditions—a single or two-operator unit, gasoline-engine-driven, belt-driven or motor-driven, with capacities of 10-250, 10-300, 10-600, 15-500, 15-1000 amperes. Write today for bulletins describing Wilson Welding Machines, and ask for a sample of Wilson "Color-tipt" Welding Wire, indicating the kind of metal you wish to weld. There is no obligation.

Trade Mark Reg.
U. S. Pat. Off.

WILSON WELDER & METALS CO. INC., WILSON BUILDING, HOBOKEN, N. J.

WILSON

WELDING MACHINES AND WELDING WIRE

GLOVES (Asbestos)
Ideal Face Shield Co.

GAUGES
Moto Meter Co.
National Gauge & Equipment Co.

GENERATORS (Acetylene)
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
M. Keith Dunham
Imperial Brass Mfg. Co.
Milburn, Alexander Co.
Modern Engineering Co.
Oxweld Acetylene Co.

GOGGLES
Chicago Eye Shield Co.
Ideal Face Shield Co.
Willson Goggles, Inc.

GRAPHITE (Rods, Blocks, Paste, Etc.)
Joseph Dixon Crucible Co.

GRINDERS (Portable Electric)
Biax Flexible Shaft Co.
R. G. Haskins Co.
Stoody Company.
N. A. Strand & Co.

HELMETS (Arc Welding)
Allan Mfg. & Welding Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.
Willson Goggles, Inc.

HOSE COUPLINGS
Carl A. Norgren Co.
See also under "Needle Valves"

HYDROGEN
Gas Products Association
International Oxygen Co.

HYDROGEN GENERATING PLANTS
International Oxygen Co.

LEAD WELDING UNITS
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

LIGHTERS (For Gas Torches)
Air Reduction Sales Co.
Bastian-Blessing Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.

MANIFOLDS
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co
Victor Oxy-Acetylene Equipment Co.

MECHANICALLY OPERATED CUTTING AND WELDING TORCHES
Air Reduction Sales Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.

MOLDING MATERIAL
See "Fire Proof Plastic Material"

MONEL METAL RODS AND ELECTRODE
Central Steel & Wire Co.
Wilson Welder & Metals Co.

NEEDLE VALVES
Air Reduction Sales Co.
Bastian-Blessing Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co
Victor Oxy-Acetylene Equipment Co.

NICHROME WELDING WIRE
Driver-Harris Co.

NITROGEN
Air Reduction Sales Co.
Gas Products Association
Linde Air Products Co.
International Oxygen Co.

OXYGEN
Air Reduction Sales Co.
American Oxygen Service Co.
Buckeye Oxygen Co.
Gas Products Association
International Oxygen Co .
Linde Air Products Co.

OXYGEN PRODUCTION PLANTS
Keith Dunham Company
Heylandt Sales Co.

PREHEATING DEVICES AND OVENS
Imperial Brass Mfg. Co.
Metal & Thermit Corn
St. Paul Welding & Mfg. Co.

RAIL BONDS
Una Welding and Bonding Co.

RAIL JOINT WELDERS
Una Welding and Bonding Co.

REAMERS (Portable Electric)
R. G. Haskins Co.
N. A. Strand & Co.

REGULATORS
Air Reduction Sales Co.
Bastian-Blessing Co.
American Oxygen Service Co.
Buckeye Oxygen Co.
Craftsweld Equipment Co.
Fusion Welding Corporation
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Stoody Company
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.
Williams & Co.

SEAM WELDERS
See "Electric Resistance Welders"

SWEDISH IRON WELDING WIRE
Bissett Steel Co.

SPOT WELDERS
See "Electric Resistance Welders"

TANK CONNECTIONS
Air Reduction Sales Co.
Bastian-Blessing Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.

THERMIT WELDING
Metal & Thermit Corp.

TORCHES (Welding and Cutting)
Air Reduction Sales Co.
American Oxygen Service Co.
Buckeye Oxygen Co.
Craftsweld Equipment Co.
Bastian-Blessing Co.
Fusion Welding Corporation
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Stoody Company
Torchweld Equipment Co
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.
Williams & Co.

TRUCKS (Cylinder)
Air Reduction Sales Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Torchweld Equipment Co.

VALVES
Air Reduction Sales Co.
International Oxygen Co.
Kerotest Mfg. Co.

WELDING COMPOUND (for Shape Welding)
Air Reduction Sales Co.
Joseph Dixon Crucible Co.
Modern Engineering Co.
National Carbon Co.

WELDING ROD HOLDERS
C. Sorensen

WELDING RODS AND WIRE
See "Electrodes" and "Filler Rods"

ALPHABETICAL INDEX TO ADVERTISERS

A

Air Reduction Sales Co. 3
Allan Mfg. and Welding Co. 65
American Brass Co., The 53
American Oxygen Service Co. ....Front Cover
American Steel & Wire Co. 61
American Welding Society 62
Anti-Borax Compound Co. 64
Atlas Foundry Co. 56

B

Bastian-Blessing Company 29
Biax Flexible Shaft Co. 66
Bissett Steel Co. 55
Buckeye Oxygen Co. .....Front Cover
Burke Electric Co. 56

C

Central Steel & Wire Co. 9
Chicago Eye Shield Co. 62
Chicago Steel & Wire Co. 59
Commercial Acetylene Supply Co. 58
Craftsweld Equipment Co. ....
Crown Aluminum Solder Co. 65

D

Dixon Crucible Co., Joseph 64
Driver-Harris Co. 60

E

Elec. Arc Cutting & Welding Co. .Back Cover
Elkon Works, Inc. .....Inside Back Cover
Electric Welding Machine Co. ....

F

Federal Machine & Welder Co. 59
Fibre Metal Products Co. 66
Fusion Welding Corporation 59

G

Gas Products Assn. 10
General Electric Co. 16, 17, 18
Gibb Welding Machine Co. 63
Goodman Electric Mach. Co. 54

H

R. G. Haskins Co. 65
Hollup, C. H. ....

I

Ideal Face Shield Co. 64
Imperial Brass Mfg. Co. 61
International Oxygen Co. 54

K

K-G Welding Co. 57
Kinkead, R. E. 66
Koro Corporation 62
Krembs & Co. ....

L

Lincoln Electric Co. 20
Linde Air Products Co. 12

M

Miller Aluminum Solder Co. 62
Metal and Thermit Corp. ....
Alexander Milburn Co. ....
Modern Engineering ....
Moto Meter Co. 2
Mueller Brass Co. 21

N

National Carbide Co. 57
National Carbon Co. ....
National Gauge and Equipment Co. 2
Northwestern Mfg. Co. 63
Norgren, C. A., Co. 64

O

Owen Electric Mfg. Co. 15
Oxweld Acetylene Co. 14, 25

P

Page Steel & Wire Co. 58
Pierce, R. C. ....
Pressed Steel Tank Co. 55
Prest-O-Lite Co., Inc., The 13

Q

Quasi Arc, Incorporated 19

R

Reid-Avery Co., Inc. 4
Roebling, John A., Sons Co. 26

S

Seneca Wire Mfg. Co. 55
Sorensen, C. 66
Shawinigan Products Corp. 65
Standard Steel & Wire Co. 54
Steel Sales Corp. ....
Strand, N. A., & Co. 66
Stoody Co. 64
S. O. S. Welding Corp. 54
St. Paul Welding & Mfg. Co. 66

T

Torchweld Equipment Co. 60

V

Victor Oxy-Acetylene Equipment Co. 11

W

Weldene Corporation ....
Weldit Acetylene Co. 62
Westinghouse Electric & Mfg. Co. ....
Wickwire Spencer Steel Corp. 56
William Wharton, Jr., & Co., Inc. ....
Williams & Co., Inc. 63
Willson Goggles, Inc. 63
Wilson Welder & Metals Co. 7

Ample Stocks Tested Wire Always Ready

Above—
Portion of normal supply of rods for gas welding, carried in Chicago warehouse

Below — Main Office and Warehouse, Chicago

WELDING CARBONS

We have recently become distributors of the products of

NATIONAL CARBON CO., INC.
Cleveland, Ohio

Our stock of National Welding Carbon Products is complete and includes Carbon Plates, Rods, Paste, Welding Electrodes and Graphite Electrodes.

NOT only can we ship the day your order arrives, but we can fill that order with wire which we have proved to be just right for your work. We have hundreds of tons to select from and the characteristics of every last bundle are carefully recorded. The SWEDOX welding wire book will help to get you acquainted with this great stock of wire. We will gladly send a copy to you.

Central Steel & Wire Company

CHICAGO, ILL.
4545 S. Western Blvd.
Lafayette 8500

DAYTON, OHIO
East Monument Ave.
Extended
East 150

DETROIT, MICH.
5001 Bellevue Ave.
Whittier 6780

SWEDOX

WELDING RODS, WIRES and ELECTRODES

Patronize Your Local Oxygen Plant

SPEND YOUR DOLLARS AT HOME
for
OXYGEN

ACETYLENE HYDROGEN
WELDING EQUIPMENT CARBIDE CUTTING EQUIPMENT

Members of the Gas Products Association can give you prompt and efficient service from over 100 plants and warehouses located throughout the country.
These are your local industries from which you will always obtain courteous, personal service. From them you will secure the highest purity of oxygen, acetylene and hydrogen and technical service, if you require it, concerning your welding and cutting problems.
Have you received your copy of the "Gas Welding and Cutting Flame?" It will tell you many interesting things about welding and cutting.
Write or wire to the nearest plant asking for a salesman or a service engineer, as your requirements may demand.

BUY AT HOME FROM YOUR NEIGHBORS

ALABAMA
Birmingham—Burdett Oxygen Co.
Birmingham — Standard Gas Products Co. of Alabama.
Mobile—Louisiana Oxygen Co.

ARKANSAS
El Dorado—The Bain-Beaird Co., Inc.

CALIFORNIA
Bakersfield — California Compressed Gas Co.
Fresno—California Compressed Gas Co.
Long Beach — California Compressed Gas Co.
Los Angeles — California Compressed Gas Co.
Oakland—California Compressed Gas Co.
Redding—California Compressed Gas Co.
Sacramento — California Compressed Gas Co.
San Bernardino — California Compressed Gas Co.
San Diego — California Compressed Gas Co.
San Francisco—California Compressed Gas Co.
San Jose — California Compressed Gas Co.
Santa Barbara — California Compressed Gas Co.
Stockton—California Compressed Gas Co.
Taft — California Compressed Gas Co.
Ventura—California Compressed Gas Co.

COLORADO
Denver—Colorado Compressed Gas Co.
Pueblo — Colorado Compressed Gas Co.

DELAWARE
Wilmington—Paschall Oxygen Co.

GEORGIA
Atlanta—Burdett Oxygen Co.

IDAHO
Boise—Utah Compressed Gas Co., 319 Broadway, P. O. Box 499.

ILLINOIS
Aurora—Acme Oxy-Acetylene Co.
Chicago—Acme Oxy-Acetylene Co.
Chicago — Burdett Oxygen & Hydrogen Co. of Chicago.
Chicago—Swift and Company.
Elgin—Wisconsin Oxygen-Hydrogen Co.
Freeport—Wisconsin Oxygen-Hydrogen Co.
Joliet — Acme Oxy-Acetylene Co.
Peoria—Electrox Co.
Rockford — Wisconsin Oxygen-Hydrogen Co.
Rockford — Acme Oxy-Acetylene Co.

INDIANA
East Chicago — Acme Oxy-Acetylene Co.
Evansville—Kentucky Oxygen-Hydrogen Co.
Indianapolis—Indiana Oxygen Co.
Logansport — Logansport Oxygen Co.
South Bend—Burdett Oxygen-Hydrogen Co. of Chicago.

IOWA
Bettendorf—Bettendorf Oxygen Hydrogen Co.

KENTUCKY
Louisville—Kentucky Oxygen-Hydrogen Co.

LOUISIANA
Monroe—The Bain-Beaird Co., Inc.
New Orleans—Louisiana Oxygen Co.
Shreveport — The Bain-Beaird Co.

MICHIGAN
Detroit—Burdett Oxygen Co. of Detroit.
Detroit—Wall Bros. Co.
Flint—Wall Bros. Co.
Grand Rapids—Grand Rapids Welding Supply Co., Inc.
Muskegon — Michigan Ox-Hydric Co.
Saginaw—Wall Brothers Co.

MINNESOTA
Minneapolis—Commercial Gas Co.

MISSOURI
Kansas City—Kansas City Oxygen Gas Co.
Kansas City — Ox-Hydrogen Mfg. Co.

MONTANA
Butte — Mountaineer Welders' Supply Co.

NEBRASKA
Omaha—The Balbach Co.

NEVADA
Reno — California Compressed Gas Co.

NEW JERSEY
Camden—Paschall Oxygen Co.
Newark—International Oxygen Co.
New Brunswick—International Oxygen Co.
Paterson — International Oxygen Co.
Plainfield—International Oxygen Co.
Trenton—Paschall Oxygen Co.
Trenton—International Oxygen Co.

NEW YORK
Brooklyn—International Oxygen Co.
Long Island City—International Oxygen Co.
New York—International Oxygen Co.

OHIO
Cincinnati—Ohio Valley Oxygen Co.
Cleveland—Burdett Oxygen Co. of Cleveland.
Columbus—Gas Products Co.
Niles—Ohio Oxygen Co.
Toledo — International Oxygen Co.

OKLAHOMA
Oklahoma City—The Burdett Oxygen Co. of Oklahoma.

OREGON
Astoria—Portland Oxygen & Hydrogen Company.
Bend—Portland Oxygen & Hydrogen Company.
Corvalis—Portland Oxygen & Hydrogen Company.
Eugene—Portland Oxygen & Hydrogen Company.
Klamath Falls—Portland Oxygen & Hydrogen Co.
Medford—Portland Oxygen & Hydrogen Company.
Pendleton—Portland Oxygen & Hydrogen Company.
Portland—Portland Oxygen & Hydrogen Co.
Roseburg—Portland Oxygen & Hydrogen Company.

PENNSYLVANIA
Allentown—Paschall Oxygen Company.
Lancaster — Paschall Oxygen Company.
Lebanon — Paschall Oxygen Company.
Philadelphia—Paschall Oxygen Co.
Pittsburgh—Burdett Oxygen & Hydrogen Co.
Reading — Paschall Oxygen Company.
Verona—International Oxygen Co.
York—Paschall Oxygen Company.

TENNESSEE
Chattanooga—Burdett Oxygen Co. (of Chattanooga).
Knoxville—Burdett Oxygen Co. (of Chattanooga).
Nashville—Burdett Oxygen Co. (of Chattanooga).
Nashville—Kentucky Oxygen-Hydrogen Co.

TEXAS
Austin—Capital Battery Co. (Burdett.)
Beaumont—Magnolia Gas Products Company.
Dallas—American Welding Co. (Burdett.)
Ft. Worth—Burdett Oxygen Co. of Texas.
Galveston—Gregory Auto Supply Co. (Magnolia.)
Houston—Magnolia Gas Products Co.
Ranger—Oil Belt Welding Supply Co. (Burdett.)
San Antonio—Magnolia Gas Products Co.
Temple—Russell Transfer Co. (Burdett.)
Waco—McCrary Transfer Co. (Burdett.)
Wichita Falls—Burdett Oxygen Co. of Texas.

UTAH
Salt Lake City—Utah Compressed Gas Co.
Ogden—Utah Compressed Gas Co.

WASHINGTON
Aberdeen — Washington Compressed Gas Co.
Bellingham—Washington Compressed Gas Co.
Everett — Washington Compressed Gas Co.
Seattle — Washington Compressed Gas Co.
Spokane—Spokane Oxy-Acetylene Co.
Tacoma — Washington Compressed Gas Co.

WISCONSIN
Appleton — Universal Oxygen Co.
Beloit—Wisconsin Oxygen-Hydrogen Co.
Fond du Lac—Universal Oxygen Co.
Green Bay—Universal Oxygen Co.
Janesville—Wisconsin Oxygen-Hydrogen Co.
Kenosha—Wisconsin Oxygen-Hydrogen Co.
Lake Geneva—Wisconsin Oxygen-Hydrogen Co.
Madison—Universal Oxygen Co.
Manitowoc—Universal Oxygen Co.
Milwaukee—Universal Oxygen Co.
Oshkosh — Wisconsin Oxygen-Hydrogen Co.
Racine—Wisconsin Oxygen-Hydrogen Co.
Sheboygan—Universal Oxygen Co.

HAWAII
Honolulu—Hawaiian Gas Products, Ltd.

BOLD FACE TYPE signifies Manufacturing Plants.
LIGHT FACE TYPE indicates warehouses.

Gas Products Association

140 So. Dearborn St. Chicago, Ill.

First to Advocate High Purity Oxygen

Announcing!!!

The *New* Victor Pressure Regulator

SIMPLE fairness to this remarkable regulator calls for words seeming extravagant. ¶ From an engineering standpoint the Victor regulator is radically new, radically different and thoroughly original. ¶ Subjected to long and grueling tests it has emerged completely the "Victor" ready to serve without compromise. ¶ It compares with no other pressure regulator because no other regulator provides features that are comparable.

Three revolutionary new principles differentiate the Victor from all other pressure regulators.

1. **Its design precludes spontaneous combustion of the regulator seat.**
2. **Eliminates freezing.**
3. **Assures sensitiveness and absolute pressure accuracy.**

You will find it to be the pressure regulator for which you have been waiting.

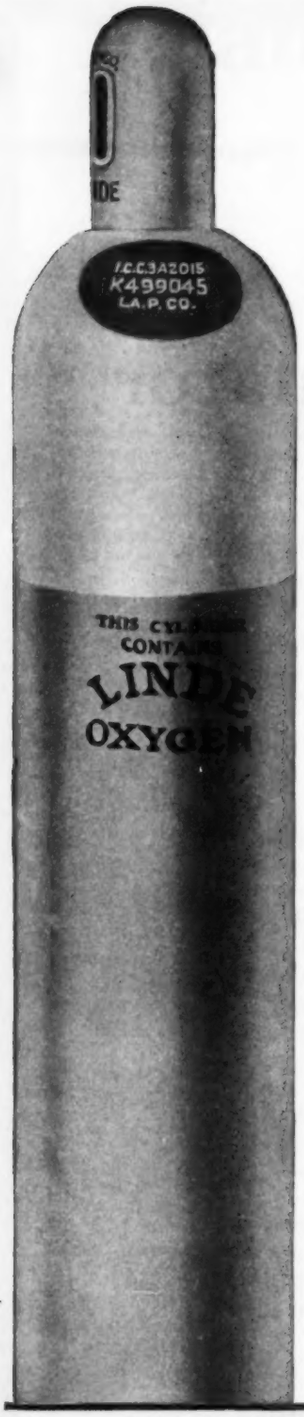
In the design and production of this new pressure regulator Victor adhered strictly to the standards of dependability which have distinguished their products for more than fifteen years.

The new Victor Regulator achieved a result which will revolutionize the standards upon which you have based your conception of *the ideal pressure Regulator*.

VICTOR OXY-ACETYLENE EQUIPMENT COMPANY

Executive Offices: 844 Folsom Street, SAN FRANCISCO, CALIF.

Manufacturers of Fine Welding and Cutting Equipment



There must be a good reason why

Linde Oxygen is the largest selling oxygen on the market.

There is.

Linde customers get more for their money.

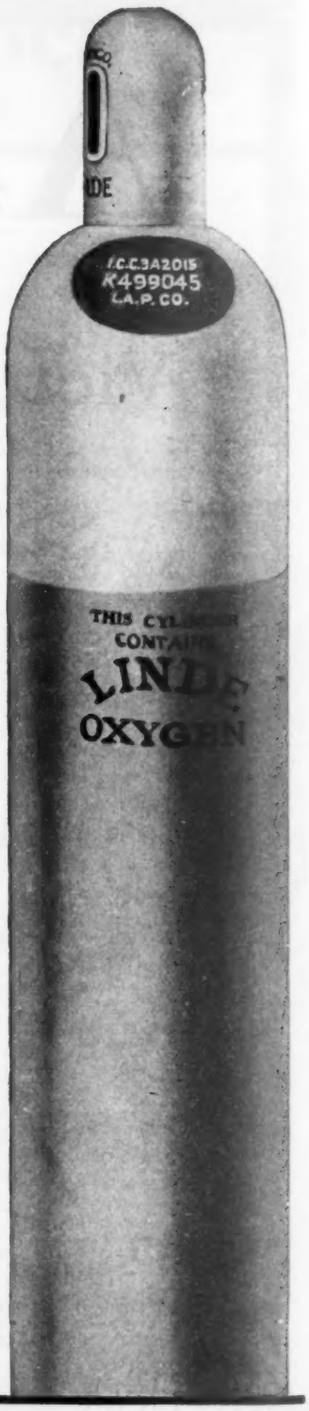
They get a good product, immediate delivery, and Linde Process Service that insures economical results.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation

UCC

General Offices: Carbide and Carbon Building
30 East 42d Street, New York

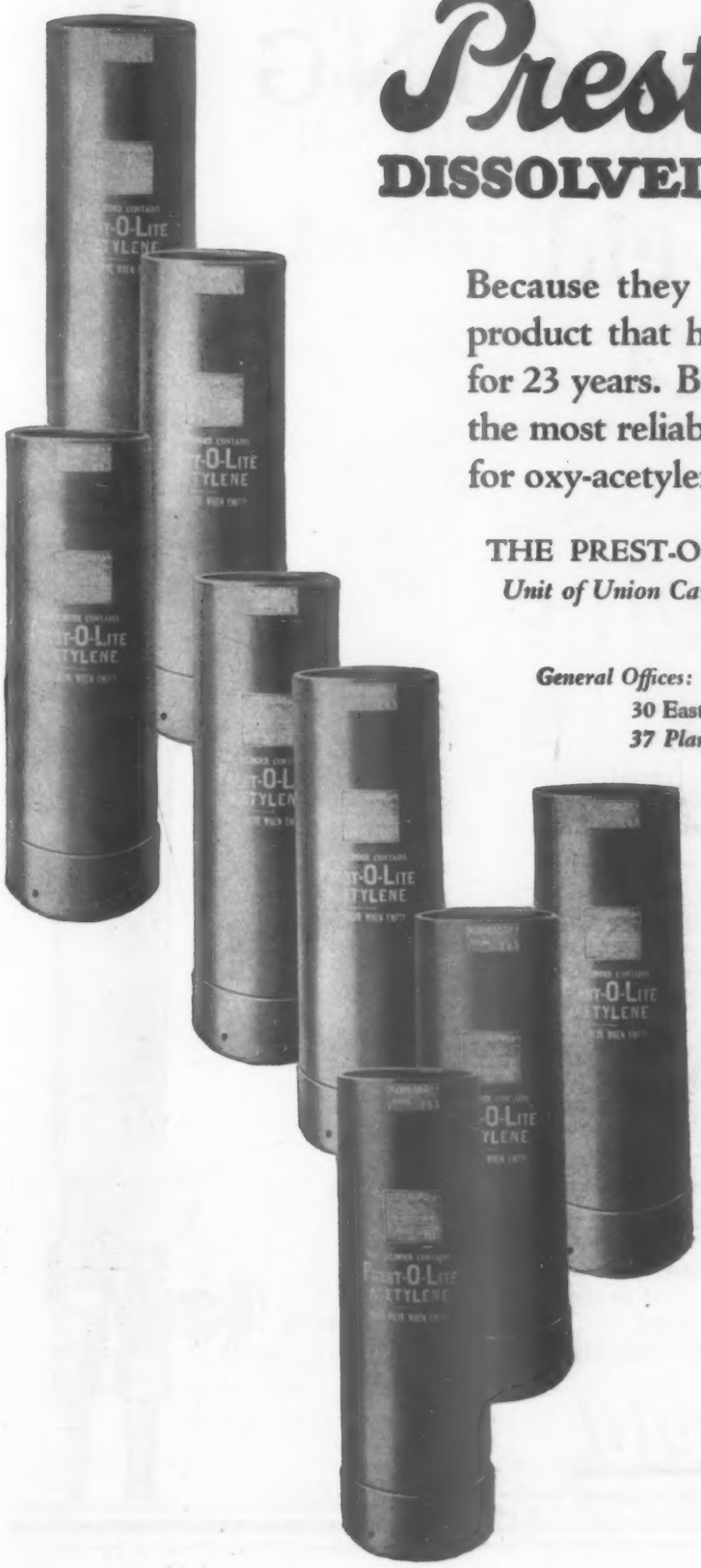
47 PLANTS . . . . . 105 WAREHOUSES



LINDE OXYGEN

People keep right on buying

Prest-O-Lite
DISSOLVED ACETYLENE



Because they have confidence in a product that has been manufactured for 23 years. But mainly because it is the most reliable and economical fuel for oxy-acetylene welding and cutting.

THE PREST-O-LITE COMPANY, INC.
Unit of Union Carbide and Carbon Corporation

UCC

General Offices: Carbide and Carbon Building
30 East 42d St., New York
37 Plants—102 Warehouses

INTRODUCING

Oxweld C-14 cutting blowpipe

IF YOU are perfectly satisfied with your cutting blowpipes, don't ask to have the C-14 demonstrated.

Because—

Every time this new member of the Oxweld family is demonstrated, it makes a convert.

It has all the inherent advantages of the Oxweld injector type blowpipe.

It can be used with either low or medium pressure acetylene. And you can't make it back-fire.

OXWELD ACETYLENE COMPANY

UCC

Unit of Union Carbide and Carbon Corporation

NEW YORK CITY, 30 East 42d Street

CHICAGO, Peoples Gas Building SAN FRANCISCO, 8th and Brannan Sts.

STOCKS IN 41 CITIES

IN CANADA, Dominion Oxygen Company, Ltd., Toronto

Oxweld

WELDING AND CUTTING APPARATUS

Notice—

the simplicity
the compactness
the rugged construction
of the

Owen Induction Arc Welder

THE OWEN *INDUCTION* ARC WELDER
Size: 13x27x21 inches **Weight, 190 pounds**
Approved and Accepted by National Board of Underwriters

There is no longer any reason why your shop should turn down scores of jobs because you haven't the necessary equipment. The Owen will widen the range of profitable jobs your shop can handle, and it can be purchased on terms that will allow it to pay for itself in increased profits.

OWEN ELECTRIC WELDER CO.
General Distributors
717-718 W. O. W. Building **Omaha, Nebraska**

A Complete Electrode Service

When you weld a joint tightly, and want it permanently tight, you require the best electrode you can buy. There is no alternative—header joints, all kinds of pipe and tank welds, must be tough and must be lasting.

General Electric manufactures three welding electrodes. Each is exactly suited to one kind of welding.

Type "F" is a bare wire treated by a special General Electric process to obtain a stable, concentrated arc. It is used for general welding of steel.

Type "B" is best for automatic welding.

Type "A" is recommended for cast iron.

A stable arc, rapid deposition, and good penetration make speedier welding possible. Less power is consumed; less electrode is required. The bead produced is even and the weld sound. The greatest economy is thus attained—with G-E welding electrodes.

In absolute reliability of operation and over-all efficiency, G-E arc welders are unequalled. They are available in all sizes, all types—for either hand or automatic operation—for one or more operators.

GENERAL

MERCHANDISE DEPARTMENT

Handy to Your Shop

Alabama, Birmingham
Mathews Electric Sup. Co.

California, Los Angeles
Robert M. Hartwell Co.

California, San Francisco
National Welding Equipment Company

California, Whittier
Stoody Company

Canada, Toronto, Ontario
Canadian Gen. Elec. Co., Ltd.

Colorado, Denver
Hendrie & Bolthoff Mfg. & Supply Company

Georgia, Atlanta
Bird-Potts Company

Hawaii, Honolulu
W. A. Ramsay, Ltd.

Illinois, Chicago
Central States General Electric Supply Co.

Illinois, Rockford
Swords Electric Co.

Indiana, Evansville
Lake States General Electric Supply Co.

Indiana, Fort Wayne
Protective Elec. Sup. Co.

Indiana, Indianapolis
Lake States General Electric Supply Co.

Indiana, South Bend
South Bend Electric Co.

Iowa, Davenport
Crescent Elec. Sup. Co.

Iowa, Des Moines
Mid-West General Electric Supply Co.

Iowa, Dubuque
Crescent Elec. Sup. Co.

Kansas, Wichita
Sutton Elec. Sup. Co.

Kentucky, Louisville
James Clark, Jr., Co.

Louisiana, New Orleans
Oliver H. Van Horn Co.

Maryland, Baltimore
Southern Electric Co.

Massachusetts, Boston
P. F. McDonald & Co.

Michigan, Detroit
Michigan Welding Electrode & Equip. Co.

Minnesota, Duluth
Northwest General Electric Supply Co.

Minnesota, Minneapolis
Northwest General Electric Supply Co.

Minnesota, St. Paul
Northwest General Electric Supply Co.

Missouri, Kansas City
Mid-West General Electric Supply Co.

Missouri, St. Joseph
Mid-West General Electric Supply Co.

Missouri, St. Louis
Halpin & Kohlbry, Inc.

Montana, Butte
Butte Elec. Supply Co.

Nebraska, Omaha
Mid-West G. E. Sup. Co.

New York, Buffalo
Root, Neal & Co.

New York, New York
Welding Service Co.
A. J. Wilson Co., Inc.

N. Carolina, Charlotte
Southern Electric Co.

North Dakota, Fargo
Northwest General Electric Supply Co.

Ohio, Cincinnati
Lake States General Electric Supply Co.

Ohio, Cleveland
Strong, Carlisle & Hammond Co.

Ohio, Columbus
Lake States General Electric Supply Co.

Ohio, Dayton
Lake States General Electric Supply Co.

Ohio, Toledo
Lake States General Electric Supply Co.

Oklahoma, Oklahoma City
Southwest General Electric Supply Co.

Oklahoma, Tulsa
Southwest General Electric Supply Co.

Pennsylvania, Phila.
Amer. Steel Engr. Co.

Texas, Amarillo
Southwest General Electric Supply Co.

Texas, Dallas
Southwest General Electric Supply Co.

Texas, Houston
Southwest General Electric Supply Co.

Utah, Salt Lake City
Capital Electric Co.

Virginia, Norfolk
Southern Electric Co.

Virginia, Richmond
Southern Electric Co.

Washington, Seattle
Seattle Hardware Co.

Washington, Tacoma
Home Electric Co.

West Virginia, Ch'rl'ston
Virginian Electric, Inc.

Wisconsin, Madison
Crescent Elec. Sup. Co.

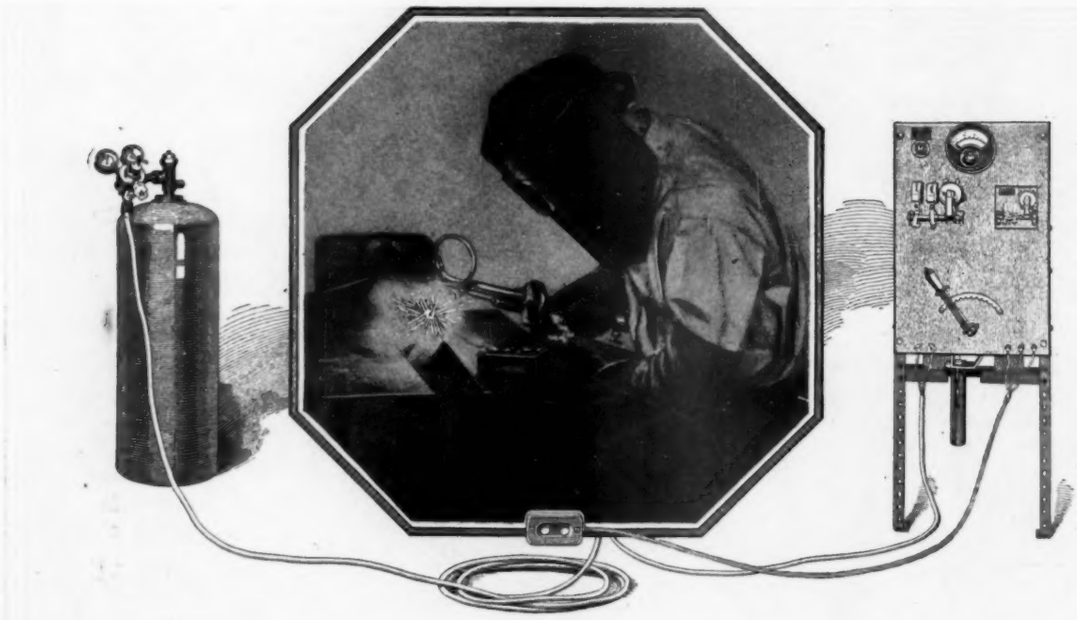
Wisconsin, Milwaukee
G-Q Electric Co.

One of these G-E Welding Electrode Distributors is located near you. His stocks are complete and ready for shipment in convenient quantities. A letter, telegram, or phone call to the nearest distributor will promptly replenish your supply of G-E welding electrodes. His is a service on which you can rely.

550-203

ELECTRIC

BRIDGEPORT, CONNECTICUT



The Atomic Hydrogen Arc Welder

This remarkable welder will produce ductile welds.

It will produce smooth welds.

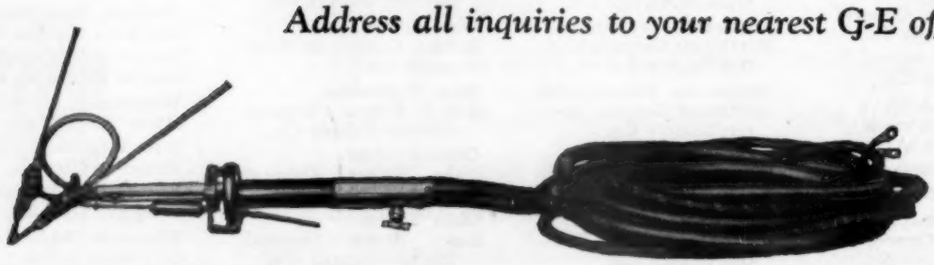
It will weld thin metals—as thin as .005 inches.

It is simply constructed, mechanically and electrically.

It is easy to operate.

It is now available for hand-welding operation from 60-cycle power supply.

Address all inquiries to your nearest G-E office.



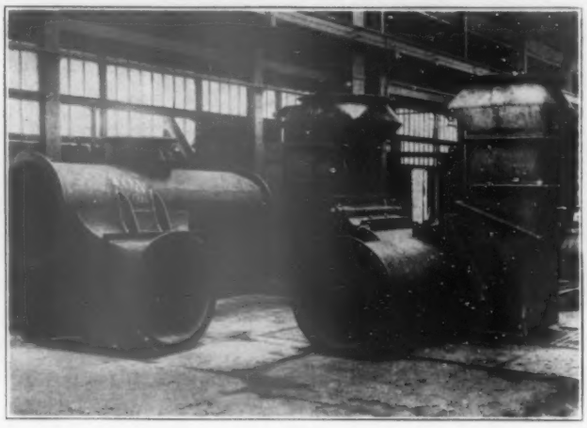
Electrode holder for atomic hydrogen arc welding

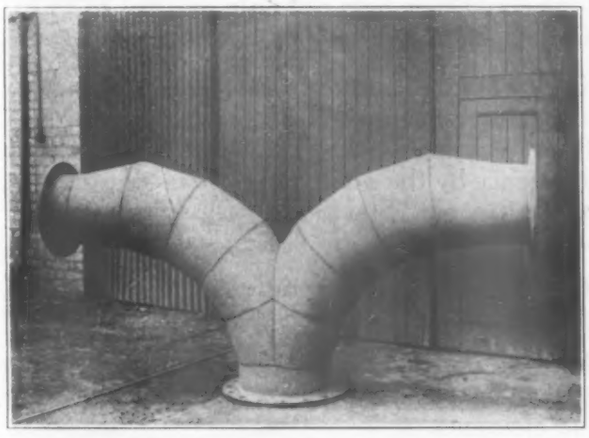
530-35

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

Quasi-Arc





Hydro-Electric Mains, Water Circulating Compartments and Steam Pipe Links all call for not only the very best welding but rigid economy in their general construction. Quasi-Arc Electrodes can solve these problems, because the metal deposited is pure and ductile.

The general design can follow the most economical rules, simple butt joints replacing the less efficient lap joints because of the high physical qualities which resist fatigue so often caused by alternating pressures. Further, a feature so often neglected, i.e., stresses at high temperatures, is positively taken care of by the Quasi-Arc deposit.

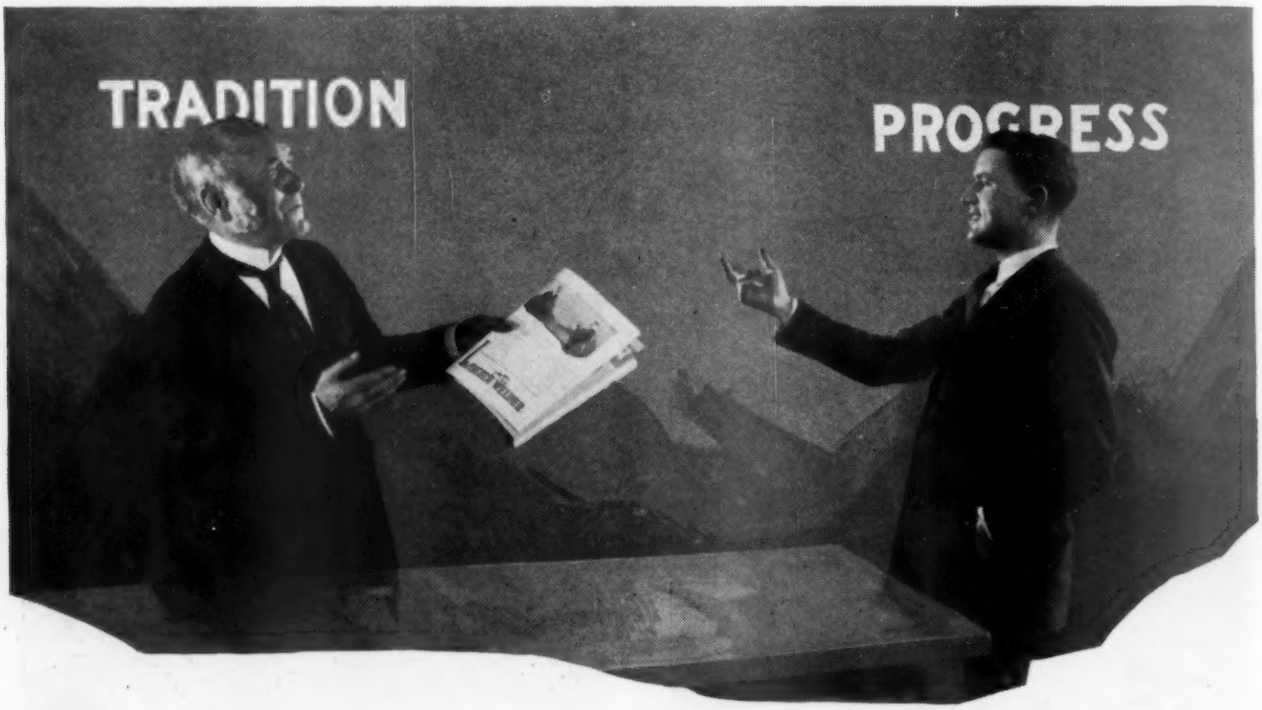
If the above facts are of interest to you we will gladly prove same in your own shop. A word from you will bring one of our Service Engineers and, with your existing arc welding equipment, A. C. or D. C. he will let your own operator demonstrate the superiority of Quasi-Arc Electrodes. At the same time our Service Engineer will gladly assist you in solving your pending welding problems.

QUASI-ARC INCORPORATED

Sole Manufacturers of Quasi-Arc Electrodes and Welding Equipments and Consultants in Reference to their Application

11 WEST 42nd STREET, NEW YORK, N. Y.

Lad talks Sense (s)



"Here Lad .....

The foreman of the welding department insisted on me getting him a supply of that "Stable-Arc" welding rod, the same as his friend is now using.

I gave him another lot of what we always used but put up in different wrapping. I didn't think the men could see the difference—but they did."

"Sure Pop .....

how could they help not only see, but to FEEL and HEAR the difference.

They could FEEL the difference in handling it, by the freer flowing of Lincoln "Stable-Arc" Blue Welding Rod. They could HEAR the difference by the non-sputter, non-splash effect of the Lincoln "Stable-Arc" Blue (non-splash) rod.

They could SEE the difference because it's BLUE in addition to non-splashing.

They could see the difference too because it's packed in steel containers to protect it from the elements.

And seeing is believing.

And Pop, since seeing IS believing, it is no wonder that our modern girls are believed."

The Lincoln Electric Co., Dept. No. 27-3, Cleveland, Ohio

W-40

LINCOLN "Stable-Arc" WELDER

Do You Know When to Use Bronze?

Steel for the end seams **100% Leak Proof** **Bronze for the fittings**

Photos by Courtesy of
ANCHOR WELDING SERVICE, CHICAGO

THE teamwork between steel and bronze gives a perfect result when each is used where it will do the most good. The work illustrated is a successful production method in the fabrication of small tanks for electric refrigerators. The principle has been extended to larger tanks up to huge storage sizes.

This is one of many production jobs in which Mueller Welding Bronze has solved a problem. Mueller Welding Bronze fuses quickly, melts at low temperature and flows evenly and freely. Absence of porosity eliminates sputtering and explosions. Make sure of the quality of your work—use Mueller Welding Bronze Rod.

Mueller
Makes

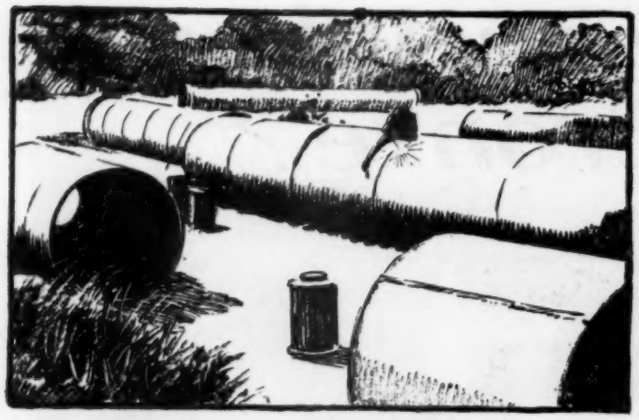
Red Tip Brass Rod
Relleum Brass Forgings
Niag Nickel Silver Rod and Forgings
Tuf-Stuf Rod and Forgings
(*Corrosion Resisting Metal*)
Sandcraft Brass Castings
Brass Screw Machine Parts
Mueller Blue Tip Bronze Rod
Brass and Copper Seamless Tubing
Mueller Blue Tip Bronze Welding Rod

Mueller Brass Co.
PORT HURON MICHIGAN
DETROIT DISTRICT

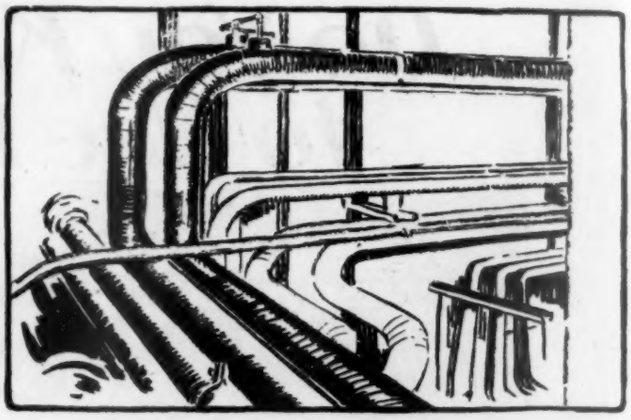
Mueller WELDING BRONZE ROD

Mueller Brass

THREE GENERATIONS OF BRASS MAKING



Operators, supervisors, and engineers on a pipe line job, who are continually facing new problems of welding procedure, need a source of information that can go right into the field with them, always ready with the answer as quickly as the questions arise. In no place more than in the oil and gas fields is The Welding Encyclopedia appreciated and relied upon by the men on the job. One reason is that it is not a book of theory alone, but of practical information which is obtained from actual experience.



The growing popularity of welding in the installing of industrial pipe systems for steam, water, oil, or gases, obligates both the piping contractor and the plant engineer to become thoroughly acquainted with the best welding practice in this class of work. The welded line insures the utmost in operating efficiency, providing the welding is properly done. As a reference volume for pipe welding facts and data, the Welding Encyclopedia is complete, reliable, and up-to-date.

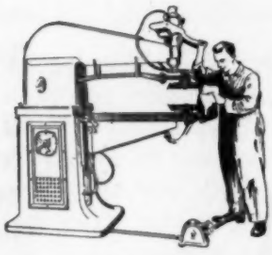
Valuable New Features in
The Welding Encyclopedia
New Sixth Edition

Electric Arc Welding

Recent improvements in both manually operated and automatic arc welding equipment, new electrode materials, and the development of new processes, all challenge your knowledge of what is the latest and best in arc welding procedure for your particular job. The latest and best is always to be found in the Welding Encyclopedia, which also contains design data for welding of building structures or of machine bases and frames.

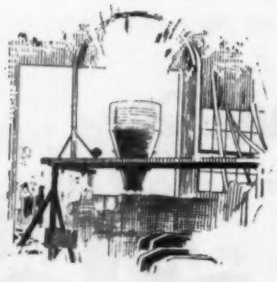
Oxy-Acetylene Welding

Within the last two years there have been many developments in the application of this process. The growing use of stainless steels, for example, has called for a special technique which has successfully welded metals formerly not considered weldable. Bronze welding, hard-facing of cutting edges and grinding surfaces, have also seen important improvements and new applications. All of these developments are fully covered in the Sixth Edition.



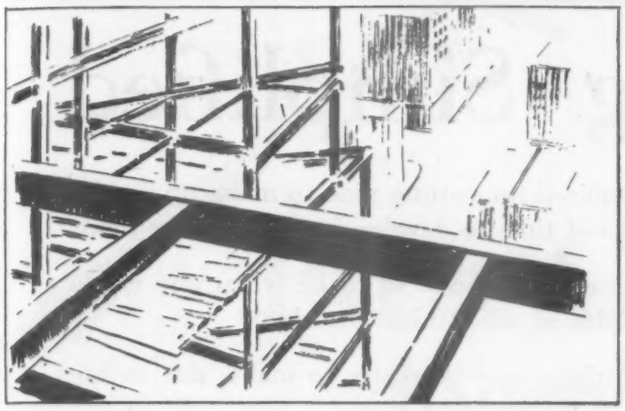
Resistance Welding

Important progress in this field has been made in the design of a great number of automatic welders for specific jobs, effecting enormous savings of time. Of importance, also, to present users of resistance welding are the new electrode metals and the methods of facing electrodes to prolong their life and to facilitate the welding of certain metals. For the fundamentals of spot, butt, and seam welding, and for the design of the variety of joints possible by this process, read The Welding Encyclopedia, Sixth Edition.

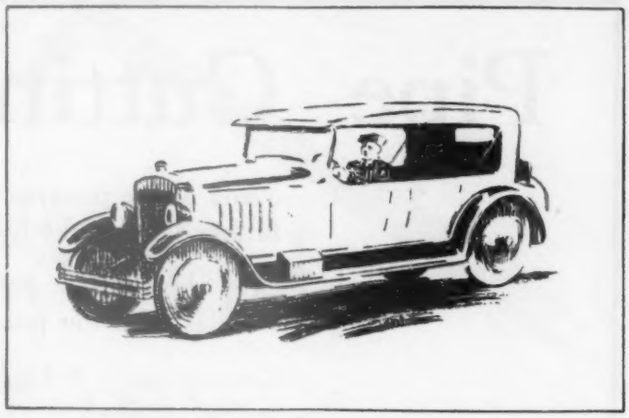


Thermit Welding

Since repair work that calls for Thermit welding is usually a large job, recent improvements in the process which have effected a considerable saving in both time and material in the making of the molds and in the welding, are of great importance to steel mills, ship yards, and other users of heavy machinery. The chapter on Thermit welding was prepared expressly for The Welding Encyclopedia, Sixth Edition.



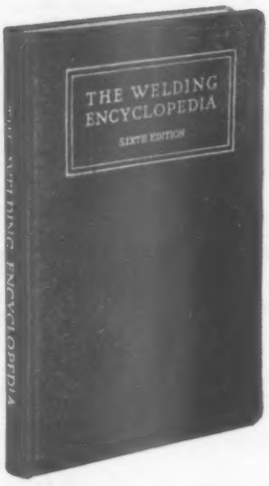
Numerous all-welded residences, factories and bridges have proved the practicality of structural welding, but few architects or engineers are yet equipped with all of the information necessary to insure both safe and economical welded construction. Do you know, for example, the amount of weld metal required to replace a rivet of a certain size? Or the design of a joint which gives to the fullest extent all of the advantages offered by welding? These and scores of other fundamental questions The Welding Encyclopedia will answer for you.



There are always opportunities to reduce costs and to improve the product if those in charge of welding are thoroughly acquainted with the latest refinements of the processes. The automobile industry has achieved remarkable economies by following this principle, and is one of the many sources of the wealth of new welding information brought together in this one volume. Thousands of copies of the Encyclopedia are now in use by production engineers who want to be informed on the most efficient welding procedure.

The Welding Encyclopedia is the only book that covers completely all branches of the art of welding.

The editorial office of The Welding Engineer is recognized as the headquarters for authoritative information and help on all branches of welding, and conducts a large volume of correspondence helping welders and welding departments out of their difficulties. In a period of eight months it was found that 95% of the problems submitted to this office were answered directly from the pages of The Welding Encyclopedia.



It tells how to weld every weldable metal by each of the welding processes. ¶ It gives detailed instructions for handling the important welding jobs, such as boiler welding, sheet metal welding, tank welding, pipe welding, etc. ¶ It tells how to prepare parts for welding. ¶ It tells how to install and care for welding equipment. ¶ It explains the meaning of all words and terms found in welding literature. ¶ It tells where to buy all standard makes of welding apparatus and supplies.

496 Pages — 645 Illustrations

Price $5.00

The table of contents below can give you only a very general idea of the scope of this work. Send for the book and give it a careful examination. We guarantee that it will be fully satisfactory and if not we will cheerfully make a refund.

Contents

1. Illustrated encyclopedia covering all words, terms and trade names used in welding.
2. Oxy-Acetylene Welding.—Aluminum, Steel, Cast Iron, Brass Bronze. (Full instructions for welding each of these metals.)
3. Electric Arc Welding.—Complete instructions for welding all metals, studding, cutting, etc.
4. Electric Resistance Welding.—Includes Butt Welding, Line Welding, Percussion Welding and Spot Welding.
5. Thermit Welding.—The most complete treatise on this process ever published.
6. Cutting Metals.—Treatises on both gas and arc cutting. Includes cast iron cutting and automatic cutting.
7. Boiler Welding.—Gas and Electric Processes. Suggestions, procedure, and standards of practice.
8. Complete chapters on Pipe Welding, Rail Joint Welding and Tank Welding, explaining procedure in detail.
9. Rules and Regulations.—What can be welded and what cannot be welded. Rules also govern the installation and operation of equipment.
10. Complete instruction courses in Electric Arc Welding and Oxy-Acetylene Welding. Lessons, Exercises, Reference Readings, Examinations.
11. Charts and Tables.—A fund of welding information at a glance. Includes color chart showing colors at various temperatures, and color chart showing proper adjustment of oxy-acetylene welding flame.
12. Condensed catalogs.—Up-to-date information about the leading makes of welding apparatus and supplies. The Buyers' Index is a convenient and reliable guide to the man who purchases or recommends welding apparatus.

THE WELDING ENGINEER PUBLISHING CO.
608 South Dearborn Street CHICAGO, ILLINOIS

Pipe Cutting Simplified

Many of the patterns required for cutting pipe to make up welded fittings would take hours of time to develop in the drawing room.

Even the simplest patterns are difficult to make when one is not familiar with the principles of mechanical drawing.

Consequently, welded fittings may be costly to make, due to imperfect cutting.

As a solution of the cutting problem, we have for sale a complete set of full size blue prints of curves, which enable you to cut your connections *correctly and accurately* the *first* time.

THIS SET INCLUDES THE FOLLOWING CONNECTIONS:

PIPE PATTERNS

2" 3 Piece Ell
2" 45° Ell
2" Rt. Angle Ell
2" Lateral
2" Round End
2" Tee

3" 3 Piece Ell
3" 45° Ell
3" Rt. Angle Ell
3" Lateral
3" Round End
3" Tee
3" Y
3" Split Bull Plug

4" 3 Piece Ell
4" 45° Ell
4" Rt. Angle Ell
4" Lateral
4" Round End
4" Tee
4" Y
4" Split Bull Plug

6" 3 Piece Ell
6" 45° Ell
6" Rt. Angle Ell
6" Lateral
6" Round End
6" Tee
6" Y
6" Split Bull Plug

8" 3 Piece Ell
8" 45° Ell
8" Rt. Angle Ell
8" Lateral
8" Round End
8" Tee
8" Y
8" Split Bull Plug

10" 3 Piece Ell
10" 45° Ell
10" Rt. Angle Ell
10" Lateral
10" Round End
10" Tee
10" Y
10" Split Bull Plug

12" 3 Piece Ell
12" 45° Ell
12" Rt. Angle Ell
12" Lateral
12" Round End
12" Tee
12" Y
12" Split Bull Plug

4x3 Tee
6x3 Tee
6x4 Tee
8x6 Lateral
8x3 Tee
8x4 Tee

12x3 Swedge Nipples
12x4 Swedge Nipples
12x6 Swedge Nipples
12x8 Swedge Nipples
12x10 Swedge Nipples
10x3 Swedge Nipples
10x4 Swedge Nipples
10x6 Swedge Nipples
10x8 Swedge Nipples
8x6 Swedge Nipples
8x4 Swedge Nipples
8x3 Swedge Nipples
6x4 Swedge Nipples
6x3 Swedge Nipples
4x3 Swedge Nipples
3x2 Swedge Nipples

CASING PATTERNS

5 3/16" 3 Piece Ell
5 3/16" 45° Ell
5 3/16" Rt. Angle Ell
5 3/16" Lateral
5 3/16" Round End
5 3/16" Tee

6 5/8" 3 Piece Ell
6 5/8" 45° Ell
6 5/8" Lateral
6 5/8" Round End
6 5/8" Tee

8 1/4" 3 Piece Ell
8 1/4" 45° Ell
8 1/4" Lateral
8 1/4" Round End
8 1/4" Tee

ODD SIZE TEES

5 3/16Cx3" I. D. Tee
5 3/16Cx4" I. D. Tee
6 5/8Cx4" I. D. Tee
6 5/8Cx3" I. D. Tee

With these curves you can make patterns for any of the above on any desired material, without the use of mathematics or drawing instruments. They will save many times their cost.

Price $20.00

An Opportunity for Job Welders

These patterns will enable you to make up welded pipe fittings, which will be better and cheaper than cast fittings. This new and profitable line of business is a fine possibility in every locality.

The Welding Engineer

608 S. Dearborn Street
CHICAGO, ILLINOIS

Prest-O-Weld doesn't pay interest— it pays principal

YOU hear a lot of people talking about interest on an investment.

A Prest-O-Weld outfit for oxy-acetylene welding and cutting doesn't pay interest. It pays principal. It pays back your expenditure and then keeps right on making a profit for you.

Prest-O-Weld is a good buy because it is reasonably priced and because it is well made (by the makers of the famous Oxweld blowpipes).

Sold by jobbers everywhere.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC

CHICAGO
Peoples Gas Building

NEW YORK CITY

SAN FRANCISCO
8th and Brannan Sts.

PREST-O-WELD

Roebling

Welding Wire can always be relied upon for uniformity and perfect flowing quality. Roebling Electrodes are carried in all the standard sizes (14 inch lengths), also Gas Welding Wire (36 inch lengths.) Other sizes required will be manufactured to order. Tell us the kind of metal you desire to weld—we will supply the wire which will give the best results.

Send for booklet A-529

John A. Roebling's Sons Company, Trenton, N. J.

EDITORIAL

Learn All the Advantages

A MANUFACTURER of heavy duty machinery, who has recently introduced a new piece of equipment, mentions among other innovations the feature of welded construction of the frame of the machine. The whole structure is assembled by welding rolled steel shapes to forgings. Undoubtedly some saving is occasioned by this method of construction but from this manufacturer's view it is a secondary consideration because he places emphasis on increased strength and rigidity of the structure, making a direct comparison with bolted construction, which leaves the way open for slipping or weaving of some of the members of the assembly. Here then is another advantage of welded construction which may be added to the rapidly growing listing of points in its favor. Those who are working to introduce welding as a fabrication process cannot afford to rely upon one or two advantages of welded construction which were pointed out by the pioneers in the industry. Welding as a manufacturing process must be studied from a great many angles in order to be able to present it in the strongest possible way to those who have not considered possibilities from any point of view except that of cost.

Sell Welding On Quality

BUSINESS men seem to differ a great deal on the question of how to sell a new product or a new service. There are some who believe that everything new must offer to the public the advantage of a lower price while others maintain that a new product can be sold regardless of price if it offers to the public improvements over anything which has been available in the past. The promotion of the welding processes for pipe line installation gives both of these groups an opportunity to prove that they are right. Pipe welding can be sold either as a cheaper process or as a better process. There is, however, some risk involved in placing too great emphasis on its cheapness because this argument does not do justice to the value of welding for pipe installations and also because it seems to accept the proposition that old-fashioned methods of joining pipe are satisfactory. When welding is proposed as a superior method of making pipe installations we get down to brass tacks and insist that the old methods are not satisfactory. They involve greater possibilities of leakage, far more expensive repair and maintenance costs, difficulties in making changes after installation and in many cases a less efficient system. The logic of the quality argument becomes more apparent when it is realized that fittings and couplings are used, not because they are desirable but because they are necessary. In other words because it is impossible to produce a complete piping system of any size such as a power plant installation or a cross country oil carrying line all in one piece. This would be the ideal solution of any fluid transmission problem. The welding process comes far nearer to this ideal solution than any other method of joining the pipe lengths which are available because it gives practically the effect of a one-piece construction when it is properly done. It happens that the use of welding will generally prove also to be lower in cost but when the advantages are carefully studied the amount of economy involved really seems like a small matter compared to the relief from the disadvantages involved in joining pipe by old-fashioned methods which have been used for years because there was no other way and not because they were satisfactory.

Small Welds on Large Production

LIGHT production welding need not necessarily be restricted to products which need to be welded throughout. In any hardware store or kitchen or toy department of a large department store there can be found a great variety of products which would be improved by a small amount of welding. There are seams held together by rivets and other types of light connections which very quickly become loose when the products being to get rough usage. The life of a great many of them would be multiplied by substituting a short weld such as could be made in a few seconds with a light torch, and the connection would be a permanent and rigid one which could be depended upon to stand any stress which the parent metal would stand without breakage. This is not true of many types of mechanical joints. The cost of making these small welds is exceedingly small and can often be saved by simplified design of the pieces themselves and, of course, the actual operating cost can be kept to a very low minimum by using some ingenuity in arranging a systematic set-up so that the welder goes from one piece to another without loss of time or waste of material. It is quite evident that some manufacturers of light metal products are familiar with the advantages of this method of manufacture because it quite often happens that clerks in retail stores mention the durability of such articles and emphasize the fact that a long life is assured because the article is welded.

The Obsolescence of Ideas

AN ENTERPRISING publisher has started making a survey of all industries to determine the effect of obsolescence of equipment on possibilities of sales of new equipment. It turns out to be a very interesting subject. Many industrial executives have been astonished at the markets which exist right under their noses as a result of the obsolescence of equipment. Undoubtedly a survey of the welding industry would reveal some interesting facts for manufacturers of the equipment used and it may be possible to conduct such a survey for their benefit. However, there is another angle of the subject which it is interesting to think about and may easily serve as an inspiration to give some more aggressive sales effort; that is the obsolescence of ideas. The welding processes are being adopted in a great many places only after previous ideas about manufacturing have been replaced by the welding idea and a great deal of the expected expansion of the industry depends upon being able to substitute the idea of welded construction for previous ideas which in many factories can already be classed as obsolete.

Shall He Learn How to Weld?

MANY engineering students of today are considering seriously the advisability of making a specialty of fusion welding and its applications in industry. How far should they go in practising the technique of welding? Is it beneath the dignity of an engineer to know how to handle the torch or the arc? Or is it sufficient for them to master the purely theoretical principles? One of our foreign contemporaries discusses these questions and comes easily to the conclusion that while an engineer can not be expected to keep up the constant practice which results in perfect dexterity he certainly profits to a large extent by being able to weld better than the average operator.

Important Features of a Serviceable Regulator

The New REGO XL Regulator

The Last Word in Regulator Efficiency Safety and Economy

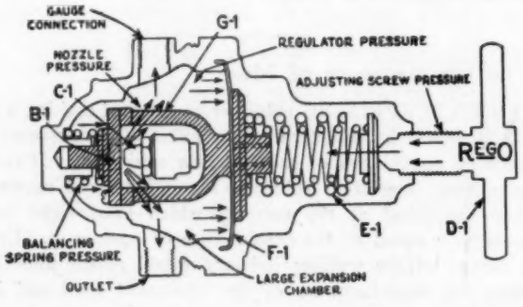
THE INTELLIGENT BUYER, when purchasing such an important part of his equipment as a Regulator, first makes sure of the experience and reputation of the manufacturer.

He then determines that there are incorporated in the construction of the regulator *safety* devices that will make it "fool proof," as it is impossible to make certain that all operators correctly use the equipment. It is necessary to protect them as well as the equipment from their own carelessness.

He must remember that the delivery of a constant *pressure* is only *one* of the essential features of a good regulator. Large *volume* of gas is absolutely necessary to meet the present-day demand for high-speed production welding and cutting.

The proper operation of the torch is dependent on a good regulator.

How the New REGO XL Regulator Operates



This is the section of a REGO Regulator. The gas enters the regulator at the inlet at varying pressures up to 2000 pounds. If the regulator is closed the seat B-1 is in contact with nozzle C-1, which prevents the gas flowing beyond that point.

When the operator is ready for the gas he turns the adjusting screw D-1 to the right until the gauge connected to the expansion chamber of the regulator registers the desired flow pressure.

When the operator turns the adjusting screw to the right he exerts pressure on the springs E-1, which, in turn, push against the diaphragm F-1. The diaphragm F-1 is securely fastened to a seat yoke, G-1. Hence the movement of the diaphragm moves the seat B-1 away from the nozzle C-1, allowing the gas to flow from the storage tank into the expansion chamber of the regulator. The pressure of the incoming gas exerts itself against the diaphragm F-1. The gas will naturally continue to flow into the expansion chamber of the regulator until sufficient pressure is built up to overbalance the pressure of the springs E-1, on the opposite side of the diaphragm, thus closing the seat against the nozzle and shutting off the flow.

The outlet of the regulator is controlled by the torch valve. As the torch valve is opened the gas flows from the regulator, diminishing the pressure against the diaphragm and allowing the spring to force the seat away from the nozzle a sufficient amount to permit the incoming gas to keep a balance of pressure against the diaphragm.

It will be noted that, with this REGO construction, any desired *volume* of gas at a fixed *pressure* can be obtained. If the flow of gas through the tip of the torch is small, the space between the seat and the nozzle of the regulator adjusts itself to supply just that quantity at the pressure set, and if the demand or flow is heavy, the space between seat and nozzle automatically increases proportionately. This is a vital feature of a good regulator.

Note particularly that no dependence is placed upon the spring to *close* the seat. In the event of foreign material on the seat the resulting excess pressure against the diaphragm will force the seat into the nozzle and stop the flow.

Write for Catalogue 51-D

The Bastian-Blessing Company

240 East Ontario St. Chicago, Ill.

REGO is sold by over 200 distributors

Expanding the Heating Plant

Oxy-Acetylene Welding Is Used Extensively in Installation of New Pipe Lines Made Necessary by Numerous New Buildings at Dartmouth College

By A. W. Birnie

WITH the building of a new library, a new Natural Science building and a new dormitory at Dartmouth College, Hanover, N. H., it became necessary to add to the heating system and also to make certain replacements.

Welded joints were decided upon for this installation and work was started in August, 1927 and completed in January of this year. Sixty-three hundred feet of genuine wrought iron pipe were used in sizes varying from two to twelve inches. The steam lines were of standard weight pipe, while the return lines were extra heavy, double thick. The welding rod was Oxweld No. 1 High Test.

The completed line is enclosed for some distance in a concrete tunnel, crosses the campus sixteen feet underground and passes under streets and buildings.

Fig. 1—Pipes Entering New Library. Welded Angles on 8-inch and 4-inch Lines, Bends on 3-inch Line.

A deep, wide trench was cut across the campus to hold the main section of the line, a steam shovel being used for this work. Two lines of soil pipe of the bell and spigot type were laid one on each side of the trench bottom to take care of drainage and these were covered with crushed stone and gravel. A layer of waterproof paper was next applied and the concrete which formed the floor of the trench was poured on top of this. Small piers were placed in the concrete at twelve foot intervals as supports for the steam and return lines. When these lines were completed multi-cell tile was built up at each side of the trench and over the top of the pipe, forming a casing about three feet high, the roof of which was supported with angle irons. The joints in the tile were then given a coat of waterproof paint, and waterproof paper was placed over the roof. Finally the trench, which was sixteen feet deep, was filled in with the aid of the steam shovel.

Branch lines were also laid in trenches varying from four to sixteen feet in depth, and single drain pipes were used beneath the tile in which the steam and return lines were laid. This tile was of the split type, one half being placed on the gravel above the drain pipe and the corresponding numbered sections put in place when the lines were completed. Tees were placed at twelve foot intervals along the tile and filled with concrete to hold the rolls which supported the pipe lines.

A concrete tunnel 7′ high, 5′ wide and 400′ long extends west from the heating plant to a pit at the rear of Hanover Inn. This tunnel contains 250′ of 12″ pipe (low pressure line) 400′ of 6″ pipe (high pressure line) and 400′ of 6″ return line. The 12″ line is supported on hangers from the roof of the tunnel. It was not possible to roll the 12″ pipe so welding was done with the pipe stationary, the ends aligned with clamps, and the usual method of tacking and welding was followed. The 6″ pipe is supported on rolls set on concrete piers, and the pipe was turned while welding. Nozzles were welded to the low pressure and return lines in the tunnel for connections to already existing branches in various nearby buildings. Ross sliding tube expansion joints are placed midway of the 6″ lines and at one end of the 12″ line. This tunnel is equipped with electric lights and ventilators and a passageway extends through the center between the pipe lines.

Fig. 2—Main Lines on Campus. New Library Tower in Background.

A 3″ low pressure line was joined to the end of the 12″ pipe, brought through an opening in the tunnel wall to a

shallow ditch and extended a distance of 275′ to the Tontine Building on Main Street. A 2″ return line parallels the 3″.

A section of 10″ pipe forms a connection from the 12″ line to Bissell Hall, a short distance from the tunnel. The return line consists of 4″ pipe. Another branch consisting of 6″ high pressure and 3″ return lines extends from the end of the tunnel to Hanover Inn.

The next section of the line extends northward from the end of the tunnel to a pit beside Webster Hall, is 800′ long and is contained in the hollow tile conduit already described. It was necessary to tunnel under two streets and bordering sidewalks to prepare for this section and the trench intersected the entire campus. The 6″ high pressure and 6″ re-

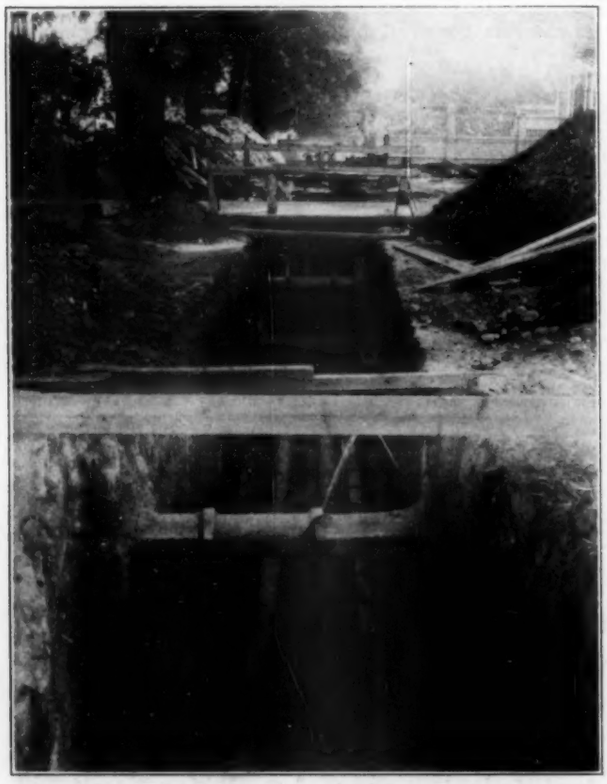


Fig. 3—6-inch High Pressure and 3-inch Return Lines Near Hanover Inn.

turn lines which comprised this section were lowered into the trench and placed in position on rolls which were set in the concrete piers. These rolls were so perfectly aligned that it was unnecessary to use clamps while welding the pipe. Therefore it was tacked and turned on the rolls as it was welded. The steam line was then raised 3″ above the rolls by means of cradles so that covering could be applied to the entire pipe surface. (All of the steam lines were raised in this manner.)

Double expansion joints were placed every 170′ on this section of the steam line and every 250′ on the return line. Spaces had been left for these as the line was welded. Screwed steel flanges were placed on the ends of the pipe next to the expansion joints anl heavy fillet welds were made around the flange hubs so that no threads were left exposed. The joints were placed in frames already set in the cement and bolted to the pipe flanges. They are placed at close enough intervals along the line so that at no time will they be taxed to their maximum capacity. These are Badger self-equalizing expansion joints and this type is used wherever the line is concealed. They are corrugated and work with a bellows-like action.

Anchors were placed on these lines midway between each expansion joint. These anchors were constructed by setting stout I beams in the concrete floor of the trench. Iron straps were placed over the pipe, bolted to the I beams and then welded to the top of the pipe.

A 4″ return line extends west across the campus from the main line to a manhole in Sanborn Lane. This line also passes under a street and is 500′ in length. For this section the pipe was welded in 80′ lengths, lowered into the trench, placed on the rolls in the split tile and the remaining joints welded. To avoid obstacles underneath the street it was necessary to divert this line on a 15° angle. The welding torch easily overcame this difficulty in the following manner. Two single expansion joints with spigot ends were mitered with the cutting torch and welded; then an anchor was placed at the welded angle. This line ended in a manhole where a connection was welded to an already existing return line. A steam line was in operation close by the return line making warm quarters for the welder.

The main line next enters a pit beside Webster Hall. This pit measures 12′ x 14′ x 16′ deep, and is so close to the Hall that the foundation stones of the building form one wall of the pit. When the work at this point was completed a reinforced concrete roof was poured and the pit is connected to Webster Hall by means of a passageway through the foundation.

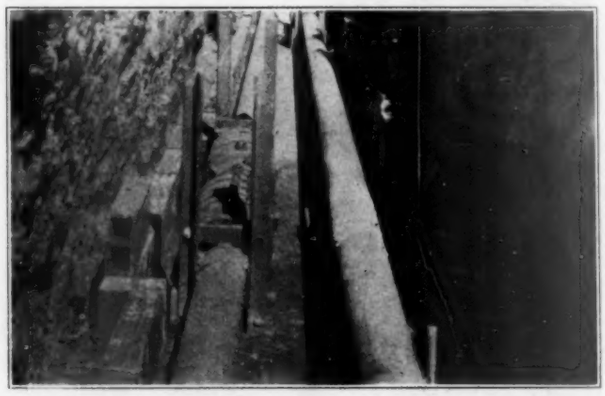


Fig. 4—Main Lines on Campus, Showing Badger Expansion Joints.

Existing 9″ and 3-½″ lines extended diagonally across the pit in the path of the new main line. Sections of these existing lines were to be removed and as this meant shutting off the steam, these lines being then in operation, it was necessary to do the work with as little inconvenience as possible. First, tee branches were welded to the top of the 9″ pipe at opposite corners of the pit. A flanged elbow and an expansion joint and valve were then placed on one tee branch and a valve was placed on the other. A loop composed of flanged fittings, valves and reducing valves was run around the pit and it was now possible to remove the required section. To do this, the pipe was cut with the same pattern used for the tee branch and the pieces which had been cut to make holes for the tee branches therefore formed ready made caps for the pipe ends and were welded into place. The new 6″ high pressure line was joined to the loop.

The value of the oxy-acetylene torch was clearly shown in this instance. The steam was shut off for only an hour or two at a time during the warmest part of the days on which this work was done. It can be readily seen that much more inconvenience would have been caused had any method other than welding been used.

The Oxweld No. 30 heating head proved to be of much value at this point as many bends had to be made. At one place where the 3-½″ pipe came very close to the 9″ it was necessary to make an offset to accommodate an expansion

joint. This offset had to be started at a point inside the encasing tile and by reaching in with the torch this was easily accomplished. Another bend was made when the 3-½" pipe was cut, formed into practically a semi-circle and welded to the new return line. Several other bends were made here including some on extra heavy 4" pipe. To make the bends the pipe was braced with wooden blocking at the proper points and pulled slowly into position with chain falls as the heating progressed.

Couplings were welded into the lines at various points throughout the pit for drips and discharges for the steam traps. Six Ross sliding tube expansion joints were used in this pit, this being the type employed in all accessible places on the line.

Three lines of pipe continue northward from the pit to the

Fig., 5—Section of Sanborn Lane Line Being Covered After Testing. Ready for Expansion Joint and Next Section.

new library building, a distance of 300'. These consist of 8" low pressure, 3" high pressure and 4" return. This section tunnels under Butterfield Museum, a building which stands directly in front of the new library and is soon to be removed. The pipes were laid in a deep trench similar to that on the campus and the same method of welding followed, except that it was necessary to use clamps on the 8" line.

The three lines entering the library foundation and those meeting them inside the building were in such positions and grades that special angles were necessary to make the connections. As shown in the accompanying picture, this task was easily accomplished with the welding torch. No matter what angle is required on a pipe line it can be made to measure right on the job by the use of the torch. Patterns are of course necessary for this work and all of those used on this pipe line were developed by the welder.

The next section leaves the library building at a point near the northwest corner and extends west to the new Natural Science building, passing under the street in its course. These lines, which are laid in the split tile, consist of 320' each of 6" low pressure and 3" return. The pipe is anchored at one end and expansion joints are located inside the Science building. More angles and bends were necessary at this point to make the inside connections.

170' each of 6" and 3" pipe form the connection between the Science building and Russell Sage Hall directly beyond, and several bends were made here. The new installation ends in Sage Hall and is here connected to the old system. Lines also extend from the old system in Hitchcock Hall to the new dormitory on Tuck Drive, welded joints being made on about 300' of 6" pipe at this point.

This new system and its connections to the old one now form a complete loop from the heating plant to the various buildings and back again, and steam can be sent in either direction around the loop.

Each section of the line was thoroughly tested as it was completed and every weld proved to be absolutely tight. All of the pipe was then coated with asphaltum paint. Magnesia covering was next applied in two layers of 1-½" thickness each on the high pressure steam lines, two layers of 1" thickness each on the low pressure and one layer on the return. Two layers of roofing paper and a final coating of paint completed the pipe covering.

Plans for this installation were made by Mr. Alfred Kellogg, Consulting Engineer of Boston, Mass., and the system was installed by the firm of F. E. Newcomb, Newport, N. H. The work was carried on under the direction of Mr. W. R. Gooding, Superintendent of Buildings and Grounds at Dartmouth and all of the welding on this line was done by the writer.

Dartmouth College was the pioneer in the use of the underground steam pipe system. The first installation of this kind was made at Hanover thirty years ago, the idea being originated by the Superintendent who was in charge of the buildings and grounds at that time.

WEEKLY ENGINEERING INDEX SERVICE ESTABLISHED BY A. S. M. E.

The inauguration of a Weekly Engineering Index Service, as an extension of the old Engineers Index which has been of immense value to members of the profession for the past 44 years, has been announced by The American Society of Mechanical Engineers. This new development of the service makes available to engineers the best of current thought and research regularly and without delay.

By this service valuable material in over 1,700 publications is reviewed by a staff of editors qualified by practical field experience. Each article is briefly described in a carefully prepared note, and these notes are classified under one of the thirteen subject headings in which different phases of engineering interest are listed. They are then printed on index cards, convenient for filing, and sent each week to subscribers.

Full information concerning this service, which is supplied practically at cost, together with sample index cards may be obtained by addressing Major Carlos de Zafra, director, Engineering Index Service, 29 W. 39th St., New York, N. Y.

METHODS OF OXYGEN PRODUCTION DISCUSSED

The third of a series of articles by F. P. Wilson, Jr., of the General Electric Company, on the subject of the application of oxygen and hydrogen to industrial operations is published in the April issue of the General Electric Review and discusses particularly the methods of oxygen manufacture and the importance of the by-product gases. Detailed descriptions are given of the liquefaction and electrolytic processes of oxygen production, with typical layouts of the equipment necessary and a table of comparative data for a hundred cubic feet per hour oxygen plant for the liquefaction process and the electrolytic process. The two processes yield different gases in addition to oxygen and all of these gases have commercial uses. The article gives an interesting discussion of the importance of these gases in relation to oxygen production.

Wanted—A Steel Weldery*

A Plant to Manufacture Welded Steel Parts on a Commercial Scale Is One of the Big Needs of the Welding Industry Today

By Hyman Levine

FOREWORD

The purpose of the competition for the Lincoln Arc-Welding Prizes is to stimulate the use of arc-welding in many fields.

My recent experiences with arc-welding and its problems lead me to believe that the number of designs already published in articles, books, and advertisements should be sufficient to start any manufacturer thinking along welding lines. What is most needed to increase the use of arc-welding is not more designs but more facilities—we need a plant to manufacture welded steel parts on a commercial scale.

It is my firm conviction that the organization of a STEEL WELDERY, such as suggested in this paper, will prove to be the most effective means of stimulating the widespread adoption of the arc-welding process.

THE use of arc-welded steel in the manufacture of machine parts and steel structures has grown rapidly in recent years, and seems likely in the near future to assume a place of importance alongside of cast, pressed, forged, and riveted steel. Articles appearing in the technical press during the last two years, and the papers presented in the Lincoln Arc-Welding Contest for 1927, show by argument, illustration, and experiment the wide variety of uses to which the process has been successfully applied in the past and can be still further applied in the future. The difficulties involved in the manufacture by arc-welding of steel-pipe, motor frames, bed plates, gear cases, cranes, columns, and even buildings have been met and overcome, the resultant structure being more rigid and more economical at the same time. That in the next few years many more uses will be found for the process, and many more manufacturers will resort to it for already known uses, is hardly a prediction; it seems almost a certainty.

Help Needed on Redesign

The manufacture not now using arc-welding on an extensive scale is, however, confronted with a serious problem. He reads the technical press and sees the successful application of the process to many parts. He reads the Lincoln prize papers and begins to feel that there may be some use for the process in making his own product. But how to redesign his product and how best to use the process are two factors on which he needs help and information, and which he will inevitably find difficult to obtain.

Limitations of Free Service

The first thought is to turn to those who most widely advertise the process—the manufacturers of arc-welding equipment and several local representatives are called in to discuss the matter—It is customary in the sale of welders, as on other machine tools, to give to prospective purchasers a certain amount of "free" engineering and design service; the principle being that the profit realized on the sale of welding equipment will be greater than the cost of the "free" engineering given to the prospect. Under present competitive conditions, the profit realized on the sale of an arc-welding costing about $900.00 is, according to authorities, about $90.00. The amount of "free" engineering available to the manufacturer to help him in the adoption of the arc-welding process is obviously less than the $90.00 margin involved, and must necessarily be considerably less, for much "advice" is given to prospects who never purchase. The recommendation of the welding equipment salesman is as expected—buy some welders and start welding. It is a recommendation that the manufacturer naturally hesitates to adopt.

Why Manufacturers Hesitate

To use the new process, under present conditions, therefore, means the purchase of new equipment, provision for additional floor space, the employment and training of welding designers and welding operators, and the inevitable mistakes, troubles, and inefficiency connected with the introduction of any new and radical feature. This, coupled with the natural uncertainty whether the process will really be applicable to his own product, makes the manufacturer hesitate a long time before going ahead. Regardless of technical advertising and the publication of prize papers, he will continue to hesitate.

A Complete Welding Service

What is needed in the arc-welding field today to really stimulate the adoption of the process is a plant and a service akin to that of the modern foundry, pressed steel plant or forge shop—a large *Steel Weldery* that would produce welded steel parts to manufacturer's orders. Such a plant, if properly organized, could offer to manufacturers a complete welding service, supplying at the outset reliable data on the cost of welded parts, redesigning present parts for welded construction, and producing for a definite and known price the necessary welded steel parts.

Types of Business Waiting for the Weldery

There must be a large number of manufacturing concerns that would welcome the appearance of such a *Steel Weldery*. One large middle western company was considering the redesign of its bed plates to welded construction and, while estimates indicated a large possible saving over present costs, it found it undesirable to do the welding in its own plant; it would have gladly placed an order with a large *Steel Weldery* to produce a number of beds for trial, and for standard production later. Another concern manufacturing pumps was confronted with a similar problem and has not yet changed over, due a similar condition. A motor manufacturing plant is doing some welding on a small scale, but could use the process in many more places, and probably would if it could buy some of its welded parts as it buys its steel castings and stampings, from a firm that is equipped to produce them and has the technical facilities and experience to make its products reliable.

Better Distribution of Expense

Work done in a *Steel Weldery* would obviously be less expensive than that distributed over a number of small plants. At the present time, welding is done by each manufacturing establishment, often on a small scale even as foundry and forge work was done in early days. The flow of work is not steady and the operators are rushed at one time and idle at another. The equipment once put in soon falls out of date and represents a waste even if kept continuously in producing. Welding operators do not, except in rare instances, keep up with the latest developments in welding methods, as would the technical staff of a *Steel Weldery*. Inspection is not as thorough and the output not as reliable as might be had were the control more rigid.

**Paper submitted in the Lincoln Prize Competition.*

A More Satisfactory Service

A *Steel Weldery* would be a boon to manufacturers of welding equipment for it would reduce their sales cost and sales resistance. "Free" engineering is expensive to the equipment manufacturer and the amount available is limited. On a prospective sale of a $900.00 machine, $90.00 is the obvious limit to which he can go without ultimate disaster. The *Steel Weldery*, dealing with the same prospect, could look for possibly $10.000.00 or more business annually, and a proportionate investment of "free" engineering could well go to $1,000.00. The *Steel Weldery* would thus relieve a heavy burden from the shoulders of the welding equipment manufacturer and would give to prospective users of the welding process a more elaborate and more satisfactory engineering service.

An Economic Necessity

The manufacturer who properly hesitates at the adoption of the welding process in his own plant could be reasonably expected to adopt it through the medium of a *Steel Weldery*. And because there are many such manufacturers and the work could be done on a quantity basis, there would soon be a call for automatic and semi-automatic machines, leading to a greater development of the arc-welding industry.

The *Steel Weldery* is today an economic necessity. When organized and introduced to the manufacturing public, it will find a place of importance alongside the steel foundry, pressed steel plant, and the forge shop. Today it offers an excellent opportunity for investment and profit.

DISCUSSION

Eric H. Ewertz, Consulting Engineer.—Many points of great interest have been brought to prominent attention in this paper by Mr. Levine and he certainly deserves our congratulations for having done so.

From our observations it is evident that proper design and the use of the most suitable welding equipment for the particular purpose that the manufacturer may be confronted with is today the most outstanding need.

Naturally each manufacturer of welding equipment through his engineering force is likely to find a design permitting the use of his particular type of welding equipment and very satisfactory results have been obtained by manufacturers in following such advice due to the high skill of the engineers associated with the various welding equipment manufacturers.

No doubt some of the present established welding shops will gradually grow in size and others will be established, that to a degree might be termed "A Steel Weldery," and the growth of such organizations will gradually eliminate the loss due to idle welding equipment now found in many plants, the work in the plant not being sufficient to keep this equipment in constant use.

I agree with Mr. Levine that a large establishment having a highly trained engineering staff and a well rounded fusion welding equipment would be a great asset to manufacturers in producing for them a better and lower cost product.

A. F. Davis, The Lincoln Electric Co.—I am convinced that the idea of a steel weldery as described by Mr. Hyman Levine is economically sound.

Those of us who have been closely associated with the development of arc welding are in a position to realize the enormous savings which can be made by substituting arc welded steel for cast iron. We likewise know, that it is a difficult matter to convince manufacturers that they can make these savings in their own shops. Perhaps, the reason for this is the cost comparisons between cast iron and arc welded construction show such a pronounced economy for arc welding that the cost figures sound too good to be true.

It is only natural that a manufacturer should hesitate to buy welding equipment until he is thoroughly convinced that it will do the things that equipment manufacturers claim for it.

A steel weldery will make it possible for the manufacturer to have his product redesigned, one part at a time, without any additional capital investment for arc welding equipment. Furthermore, there can be no disruption of production schedules while the change is being made.

Of course, this argument presupposes that the manufacturer will eventually buy his own arc welding equipment. This will not necessarily be true in every case. There will be occasions where manufacturers will prefer to have bases and other parts welded for them regularly at the steel weldery, just as manufacturers in the past have continued to buy castings from a foundry.

There is every reason to believe that the volume of work of this sort will amply justify the establishment of welderies in industrial cities.

My personal thought is that foundries who are at present losing business because of the development of arc welding might well take the lead in the establishment of welderies, and thus prepare themselves for the tremendous economic changes which arc welding is bringing about.

E. Wanamaker, Electrical Engineer, Rock Island Lines.—Mr. Levine's paper entitled, "Wanted—A Steel Weldery," is a most excellent one, and very apropos, especially so at this time.

Those who have been actively engaged in any part of the welding industry probably do not fully realize that there are many people and concerns who could make good economic use of this latest and most modern art but who are not sufficiently familiar with same to successfully introduce the art into their business of manufacture, repair or maintenance, as the case may be.

There apparently are several parallel courses which might be followed to advantage in order that more commercially possible users of the art can become familiar with it.

Mr. Levine's "Steel Weldery" is commercially comparable with steel forge shops, pressed steel shops, etc., and in my opinion is one of the most important channels for successfully extending the use of the autogenous welding art, and he has most fully and efficiently illustrated the need for such concerns. This might be called "Channel No. 1."

Channel No. 2 might well be that offered by the expert consulting and service welding engineers who can most successfully extend the use of the art by such concerns as would have a suitable load who need expert outside assistance to adapt the use of the art to their product, and to see that proper use is made of the art not only at the time of its original introduction, but also from time to time to see that their regular organization receives the occasional specialized expert assistance which in all probability is necessary to keep pace with our rapid modern development, cost reductions, etc.

Both of the above channels are necessary for the reason, as stated by Mr. Levine, that the manufacturers of welding equipment, materials and supplies have competition among themselves and cannot therefore afford in most cases to give their customers sufficient commercial advice, engineering service, etc., such as they may require.

In addition to the two channels above referred to, it would seem that it is most desirable that the manufacturers of rolled steel, who are ever desirous of extending the use of the rolled steel products, be made thoroughly familiar with advantages accruing from the use of the autogenous welding process.

We must bear in mind that one reason why rolled steel products are not so extensively used for some purposes as products of the forest, or some of their modern substitutes that can be handled by saw and hammer, lies in the fact that

even small steel structures can be assembled today only by first making use of draftsmen, then a structural shop, then erection in the field.

If the cutting torch and the autogenous welding processes are as advantageously used as they should be and no doubt will be eventually, then the use of rolled steel can be even more economically and advantageously used in a great many instances even in small structures than can be wood or some of its kindred substitutes, especially so when the ultimate life of the structure is considered. In other words, the welding arc and the welding torch and the cutting torch will replace the hammer and the saw. However, before an average small manufacturer, contractor, workman, etc., can become easily and quickly familiar with this new method of construction or building, it seems that it will be necessary for the manufacturers of rolled steel to develop and distribute in their literature welded connection and fastening details and methods in a manner somewhat similar to those now distributed for the fastening of rolled steel parts by the older methods of bolting, riveting, etc. When this is done the use of rolled steel or structural steel will be greatly extended.

If the combined efforts of those having to do directly or indirectly with the introduction of welding are directed along the channels above suggested, the extended use of the autogenous welding process will be greater by far than that which has gone before.

E. D. Bransome, Wilson Welder & Metals Company.—Mr. Levine's article, expressing a desire for steel "Weldery" deserves hearty commendation for succinctness and logical development to its conclusions. We are of the opinion, however, that his idea is not entirely a new one, as we have knowledge of a couple of companies that were formed with the same objective that Mr. Levine describes. These companies naturally desired to make a profit on their investment and have now turned to specializing in one particular branch of the welding art. This was due to the fact that with work of varied nature, each job was complete in itself and could not be run through on anything like a quantity basis. The natural result was, therefore, that the costs involved were rather high.

High costs of electric arc welding a few years ago were not of particular moment as the art was so new and competition not great. Further, industries that found out that arc welding could be used to advantage on their particular products, used welding shops for some time but upon ascertaining that the welding of a certain part of their product became a distinct operation in their production, they arranged to do the work themselves and save the profit that would go to the "Weldery." A foundry would always have its uses for manufacturers in different industries because of the high cost of equipment and having reached their present state of excellence, practically no maintenance.

All manufacturers of electric arc welders readily agree with Mr. Levine that the profit which accrues on the sale of a welding machine is not sufficient to take care of the research and experimental work that they are required to perform. Even assuming this to be so, we must look to the fact that the welding industry is in its infancy and one of the penalties of any infant industry is that the manufacturer must lay a foundation at great expense on which he hopes to realize when the wide spread demand thereby created increases the volume of his output.

Were a "Weldery" to be instituted, would it not be in the same position of a manufacturer as far as profits, particularly in view of the fact that new work would be constantly brought to them and their engineering laboratory staff might increase their overhead to the point where the cost of welded products would exceed that of those which we are attempting to supersede.

From our own experience we have found that we have benefited greatly from information given us by companies who have specialized in one phase of electric arc welding, this in combination with the interchange of information by various welding manufacturers, we find has materially added to the sum of our knowledge and will so continue.

If the object of the "Weldery" is to furnish a clearing house for welding information, i. e., the ability of manufacturers of metal products to send their problems to the "Weldery," then we are of the opinion that the "Weldery" will have to be of a high degree of excellence to obviate such clearing houses as the American Welding Society, N. E. M. A. and the American Institute of Electrical Engineers.

While we wish in no way to disparage Mr. Levine's article or ideas, we are of the opinion that the electric arc welding industry is yet in such a liquid state and so little really known of it, that it still lies within the realm of the specialists and that we will further progress by having special studies made of its special phases.

It is therefore obvious that we do not think the "Weldery" is either a pressing need or of really practical value to the electric arc welding art.

F. E. Burk, Central Steel & Wire Company.—There is considerable merit in Mr. Levine's article. It is certainly true that the expense incident to the sale of welding equipment, particularly arc welding machines, is out of all proportion to the possible profits and as Mr. Levine points out, in so many instances no sale results after a considerable sales expense is incurred.

His "Weldery" therefore, would have to be equipped in the most modern manner and what is equally important—it would have to be in charge of experts. By this I not only refer to accomplished welding engineers, but men skilled in metallurgy and chemistry. Men who would know how, not only to understand the chemistry of parent metal but, who would be capable of suggesting the proper filler rod for every problem.

The idea might be feasible, but in my opinion, its scope would always be limited. The cost of equipment and labor is so low in proportion to savings gained by employing the welding process, that a manufacturing concern of any importance who needs the welding process in production work, is bound to put in its own welding plant. I think the trend is more in that direction every day and while the average plant using this process may not have welding engineers in charge, as experienced and capable as the proposed weldery, it would be difficult to convince them to this effect, or if convinced, they would feel perfectly capable of developing engineers and welding experts of their own second to none in point of efficiency.

C. A. McCune, Page Steel and Wire Co.—Mr. Levine has put a proposition to the welding industry that is certainly worth considering. Just how it could be fostered is difficult to say. Undoubtedly such plants distributed throughout the country would replace castings to a considerable extent. It might lead to a great many industries extending welding in their own plants and perhaps encourage those who are not now using the process. It would take a great deal of sound thought, to my mind, to establish "steel welderies."

A. M. Candy, Westinghouse Electric & Manufacturing Company.—The advent of welded steel structures replacing castings has made quite an impression in the electrical industry, where both ourselves and the General Electric Co., as you know, are making up large generator, motor and turbo generator frames, using steel plate material instead of making these frames from castings. Especially in the field of large special castings like these where only a few are required the savings are tremendous, not only in cost but also in time for producing the frames. As you know the making of the pattern is entirely eliminated and the resulting frame is much lighter and considerably more strong than where castings are used. Furthermore, the section of each portion of the frame is entirely

dependable whereas in castings there is always danger of running into blow-holes, sand holes, etc.

There has been another effect of this welding program, which might be called a by-product of the welding campaign, namely, the effect of welding competition has very materially reduced prices, which have been quoted on castings by several casting manufacturers, who have already determined ways and means of decreasing the cost of their product. This result would not have happened if it had not been for the welding competition. In this manner welding is reducing our operating costs even though it may not in every case supplant the old method of producing the desired shapes in the form of castings.

Wm. Dalton, General Electric Company.—The proposed weldery would be essentially a job shop. Such shops have not been a conspicuous financial success.

There are so many skilled welders now available and it is so easy to have men trained in the art of welding that manufacturers will find it more advantageous to do this class of work in their own factories.

PROGRAM OF ANNUAL MEETING OF AMERICAN WELDING SOCIETY

The annual meeting of the American Welding Society will be held at the Engineering Societies Building, 33 West 39th Street, New York City, on April 25, 26 and 27. Following is the program:

WEDNESDAY, APRIL 25, 1928

Committee Meetings

Morning

Pressure Vessel Committee, E. H. Ewertz, Chairman.

9:30 a. m. to 12:00, Room 1101.

Presentation of Procedure Specifications to be followed in making the tanks and specimens called for in the program of the Committee. Review of co-operation expected.

Afternoon

Structural Steel Welding Committee, J. H. Edwards, Chairman.

2:00 p. m. to 5:00 p. m., Room 1101.

A review of progress made to date. Final approval of Procedure Specifications. Preliminary consideration of assignments in making up test specimens and in testing of specimens.

Evening

Nomenclature Committee, J. Owens, Chairman.

Consideration of preliminary report of Nomenclature Committee.

THURSDAY, APRIL 26, 1928

Morning

Technical and Business Sessions

9:30 a. m. to 10:30 a. m., Room 2, Business Meeting.

Report of President, Report of Tellers' Committee, Election of Officers.

10:30 a. m. to 12:30 p. m., Room 2, Technical Session.

"Welding Corrosion Resisting Steel Alloys," by W. B. Miller, Union Carbide and Carbon Research Laboratories.

Modern Developments in Oxy-Acetylene Welding of these corrosion resisting iron and steel alloys will be presented together with test and service results obtained.

"Building Up Rail Ends by the Electric Arc Process," H. E. McKee, Electric Rail Weld Service Corp.

A review of the recent developments made by the arc process in building up worn and battered rail ends and the enormous savings obtained by this method will be considered.

Afternoon

Technical Session

2:00 p. m. to 5:00 p. m., Room 2.

Preliminary Progress Report on Qualification of Welders, Inspection and Supervision, by H. H. Moss and A. M. Candy.

This committee has under way a general standard procedure specification covering the subject of Qualification of Welders, Inspection and Supervision. At this time, the committee plans to submit a progress report covering the qualification of welders, inspection and supervision in the field of structural steel and industrial piping. Later on, the committee will also cover pressure vessels and the other subjects listed above. This report will be discussed by prominent experts in pipe line and structural steel welding.

Prepared discussion of subject.

(A) Structural steel welding by C. E. Loos, American Bridge Co., and G. A. Caldwell, Mississippi Valley Structural Steel Co.

(B) Pipe welding by E. E. Shanor, vice-president, Petroleum Iron Works Co., W. C. Beakley, Whitlock Coil Pipe Co. and N. E. Wagner, Prairie Pipe Line Company.

(C) Pressure Vessels by A. O. Miller, vice-president, Reeves Bros. and L. H. Burkhart, chief engineer, Struthers-Wells Company.

Evening

Annual Dinner

FRIDAY, APRIL 27, 1928

Morning

Board of Directors and Technical Session

9:30 a. m. to 12:00, Room 1101.

Meeting of the Board of Directors, American Welding Society.

Appointment of committee chairmen and other officers. Committee reports. Discussion of Section Activities. Plans for the coming year.

Technical Session

9:30 a. m. to 12:00, Room 2.

Welding the Ford Car, by M. L. Eckman, Welding Supervisor, Ford Motor Car Company.

First hand information will be supplied as to the welding applications in the Ford Motor Company, which is probably one of the largest practical welding laboratories in the world. All processes of welding are used. The paper will be illustrated by lantern slides.

Afternoon

Annual Meeting

American Bureau of Welding

2:00 p. m. to 5:00 p. m., Room 1101.

Review of progress made by various research committees of the Bureau. Plans for future investigational activities. Election of officers. Appointment of Executive Committee.

NEW OFFICERS ELECTED FOR CHICAGO SECTION OF AMERICAN WELDING SOCIETY

Following are the new officers elected at the last meeting of the Chicago Section of the American Welding Society:

Chairman, Robert G. Longweld, Link-Belt Company, Chicago.

Vice-Chairman, H. E. Gennett, C. B. & Q. R. R.

Secretary-Treasurer, Stuart Plumley, Gas Products Association, Chicago.

Directors for three years: K. R. Hare, C. H. Hollup Corp., Chicago; B. W. Law, Air Reduction Sales Co., Chicago; George Rose, Oxweld Acetylene Co., Chicago; O. T. Nelson, Pacific Steel Boiler Corp., Waukegan, Ill.

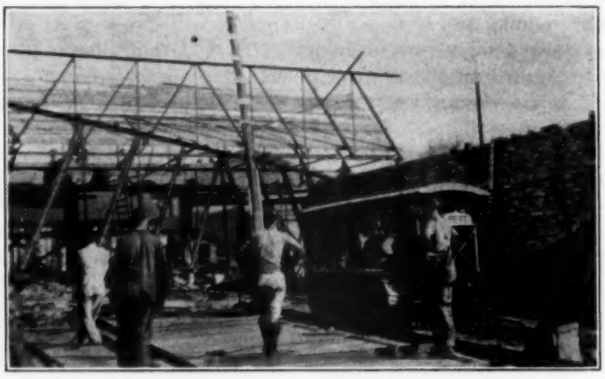
Director for two years, E. L. Mills, Bastian-Blessing Co., Chicago.

Director for one year, Robt. Malcom, Chicago Eyeshield Co.

Director to represent Chicago Section at New York Meetings of the Society, W. A. Slack, Torchweld Equipment Co., Chicago.

TWO MEN WELD NINE 50-FOOT TRUSSES IN FOURTEEN DAYS

In building an addition to their plant, the Cousins Tractor Co., of Sanford, California, electrically welded nine steel trusses 50 feet long and 10 feet high. They first had the building contractor lay a portion of the cement floor 20 feet by 60 feet, which provided a convenient place on which to

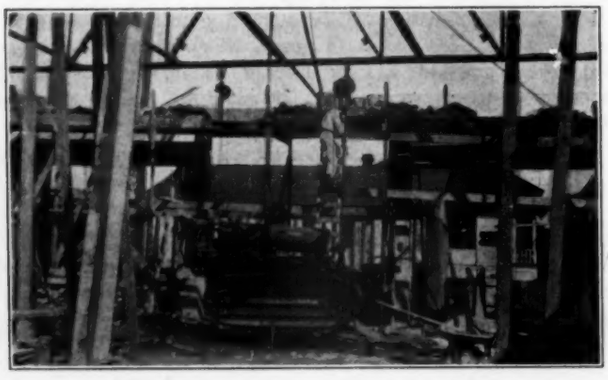


Welding One of the 50-foot Trusses.

build the trusses. By laying two of the angles which form the top and bottom chords of the trusses on the floor, the ties and struts for one side were clamped in place and welded. Then all hands were called to turn the truss and the other angles for the chords on the remaining struts were welded.

To overcome warping due to the shrinking of the steel, when the trusses were turned it was found necessary to block them up in the center until the ends swung clear of the floor, and then weight them down. In this manner we found we could build a straight truss.

As it was frequently wet underfoot, making it impossible



Testing Completed Truss by Suspending Tractor From Center.

to carry on welding in ordinary shoes, the welders conceived an ingenious idea shown in the illustration. They cut sections from old inner tubes and pulled them over their shoes, thus insulating their shoes from the damp ground.

Another view shows a five-ton "caterpillar" tractor suspended from the center of the first truss. The deflection was only 1-16 inch.

Two good welders completed each truss in an average time of a day and a half, and the cost of fabrication was $54.20 a truss.

NEW EDITION OF STANDARD STEEL AND METAL DIRECTORY

The 1928 edition of the Standard Steel and Metal Directory is now available to purchasing agents and others interested in buying machinery, equipment, iron ore, pig iron, steel, non-ferrous metals as well as ferrous and non-ferrous scrap. This edition consists of more than 1000 pages, and contains complete reports on foundries and steel mills located in the United States, giving the names of officers, location of plants, equipment, products, raw materials consumed, etc. The price of the book is $10.00, delivered. It is published by the Atlas Publishing Co., Inc., 150 Lafayette St., New York City.

GAS ORGANIZATIONS ARE PLANNING FOR SUMMER MEETINGS

The Gas Products Association is now preparing its program for the annual Mid-Summer meeting of the Association. It has finally been decided to hold this meeting at Hot Springs, Virginia, July 10-11-12. Arrangements will be made for Chicago members and those going by way of Chicago to obtain through sleepers, leaving Chicago, Monday noon, July 9th and arriving in Hot Springs Tuesday morning, July 10th. A more complete announcement of the Summer meeting will soon be prepared.

The Compressed Gas Manufacturers' Association has also decided to follow its custom of holding a Summer outing and has selected the meeting place at Sea View Golf Club, Absecon, New Jersey. This meeting will be held June 21-22-23.

Earlier in the winter there was some discussion of the possibility of arranging for these two organizations to hold a joint summer meeting, but on account of the fact that definite plans had been made by both organizations before the proposition of holding the joint meeting was discussed, it did not seem possible to change the arrangements already made for the coming summer. It is expected that some arrangement for a joint meeting can be made for the following year.

AIR EXPRESS SERVICE BUILDS GOOD WILL

The recent establishment of air express service has not received a great deal of publicity but it represents how the rapid development of modern inventions tend to eliminate the distance factor in business. Mr. Lorn Campbell, president of the Harris Calorific Company, describes his first experience with this service by telling how it enabled his plant to receive an order at one o'clock from a Chicago distributor and make delivery to the consumer on the outskirts of Chicago at nine o'clock that night. This high speed service made a big impression on the customer. It is a big advance over the best delivery possibilities which were possible before the days of the air express.

FOUNDRY RESEARCH AT MELLON INSTITUTE

Announcement has been made by Dr. Edward R. Weidlein, Director, Mellon Institute of Industrial Research, Pittsburgh, Pa., that the Whiting Corporation, Harvey, Ill., has established in the institution an Industrial Fellowship, whose holder, Dr. Edward E. Marbaker, will conduct research on cast iron. The results of these investigations will be published for the general benefit of the foundry industry.

For a number of years the Whiting Corporation has been carrying on a systematic program of development for the purpose of improving equipment and methods for the production of cast iron. It has recently been determined to expand this work and in consequence the Corporation will sustain research at Mellon Institute. Dr. Marbaker, the Whiting Corporation fellow, will work in close cooperation with the research committee of the American Foundrymen's Association.

Dr. Marbaker has been a Fellow of Mellon Institute since 1921. Previously he was chief chemist for the Westinghouse Lamp Company and for the Cleveland Wire Division of the National Lamp Works of the General Electric Company. He received his professional training at the University of Pennsylvania (B. S., 1910; Ph. D., 1914).

Resistance Welding Aids Redesign

Examples of Spot and Flash Welding in the Ford Motor Company Plant Show How These Processes Make Possible an Entirely New Kind of Automobile

WELDING is the small boy of the metal industries, grown over night into strong and vigorous manhood. Like all prodigies he inspires no little awe and wonder, and what is more to the point, there is no disputing the strength and beauty of his products.

Mr. Ford with characteristic keenness, was ahead of his time in recognizing that welding was the keystone process upon which depended the further development of the best of manufacturing processes. Accordingly, he gave the word which turned his plant into the world's greatest welding laboratory and the result shows today in the public recognition of the manufacturing achievements of his plant.

It is very easy to show that welding is today the world's best assembly method and in addition it brings into better and greater use other processes that are universally used in the production of metal goods. For example: the stamping or punch press operation is one of the prime favorites in manufacturing because each

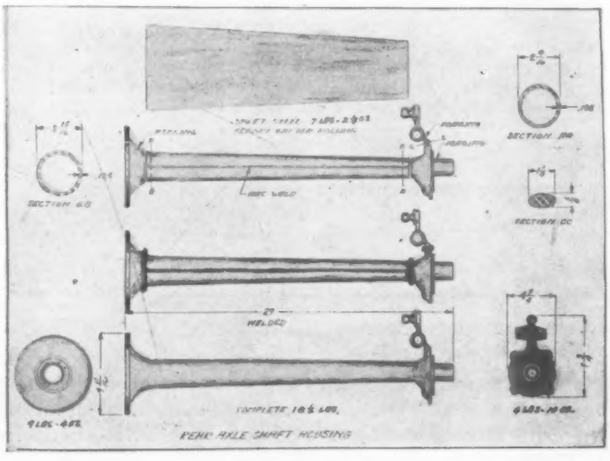


Figure 1.

piece produced is identical, the uniformity being governed by the die and not by the skill of the operator. Furthermore, the number of pieces produced is governed by the pace set by the machine as long as it is kept supplied with stock. The same principle applies to the forgings. Their lightness combined with strength and speed of production are factors which are fast causing them to supplant castings and will eventually eliminate them.

Foundries, with their core making, moulding, cupolas, shake out sand reclaiming and subsequent costly machine operations which sometimes remove as high as 30 per cent of the original weight in getting the castings into finished parts, cannot compete with the advantages of the forge shop, where by one squeeze in a forging press the heated metal is formed into a part which can be duplicated at every revolution of the press, all pieces having a minimum pre-heated amount of machine stock.

Forgings and stampings are ideal assembly materials from the manufacturer's point of view and welding makes it possible to unite them into strong, light and fine looking parts that can be designed to get best weight, strength distribution at a speed unequalled by any other known process. This manufacturing principle has been carried out in the production of a motor car in which no castings are used except in the power plant, and to the improvement in the machine are added the economies in material by the reduction of weight and by the reduction of overlap which would be necessary with other assembly processes.

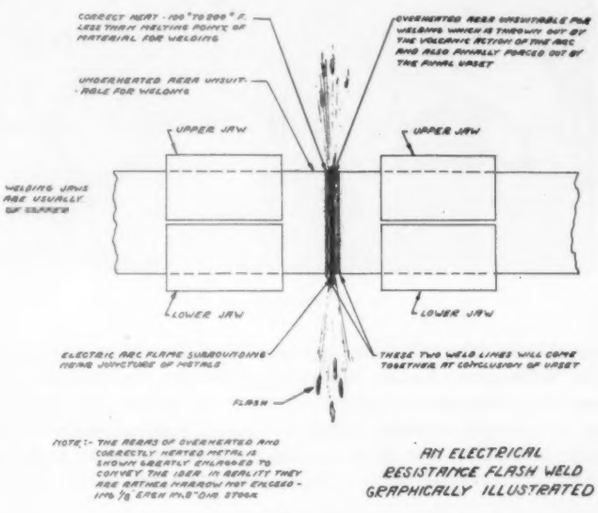

CORRECT HEAT - 100° TO 200° F. LESS THAN MELTING POINT OF MATERIAL FOR WELDING
OVERHEATED AREA UNSUITABLE FOR WELDING WHICH IS THROWN OUT BY THE VOLCANIC ACTION OF THE ARC AND ALSO FINALLY FORCED OUT BY THE FINAL UPSET
UNDERHEATED AREA UNSUITABLE FOR WELDING
UPPER JAW
UPPER JAW
WELDING JAWS ARE USUALLY OF COPPER
LOWER JAW
LOWER JAW
ELECTRIC ARC FLAME SURROUNDING WELDING JUNCTURE OF METALS
THESE TWO WELD LINES WILL COME TOGETHER AT CONCLUSION OF UPSET
FLASH
NOTE:- THE AREAS OF OVERHEATED AND CORRECTLY HEATED METAL IS SHOWN GREATLY ENLARGED TO CONVEY THE IDEA. IN REALITY THEY ARE RATHER NARROW NOT EXCEEDING 1/8 EACH SIDE OF WELD
AN ELECTRICAL RESISTANCE FLASH WELD GRAPHICALLY ILLUSTRATED

Figure 2.

The construction of the rear axle housing, as sketched in Figure 1, is one of the most interesting examples of application of these principles. The bell end is a steel forging finished by an unusual spinning operation and weighing 9¼ pounds and is assembled to the tube in one operation, an electric resistance flash weld with no overlap. The tube itself is formed from flat stock into a taper tube of great strength which is arc welded longitudinally. The wheel hub another steel forging is flash welded to the small end of the taper tube in a single operation. In comparison, the use of malleable castings for the end pieces involves reaming to a press fit, pressing together, drilling for rivets, inserting rivets and upsetting them. The amount of overlap is considerable and by eliminating this a noticable saving in weight is accomplished, this reduction in weight amounting to about 3 pounds on one housing. And these forgings being of forged special steel insure better strength and uniformity.

Such are the possibilities for the manufacturer who is able to organize his production so as to take advantage of this modern process. For over 150 years the mechanical world has been taking large masses of metal such as ingots, castings and billets and forming them mechanically by forging, planing, turning, shaping and grinding. This is a laborious, costly and by no means economical procedure. The new idea is to make these small parts quickly and economically from sheet, bars and

forgings, building them up into the forms desired. Welding makes this possible.

In order to avoid misunderstanding, let it be understood that this paper refers particularly to that special branch of welding known as "electric resistance flash welding." Undoubtedly, there are many who are not strong advocates of this one process and it is admitted that all of the welding processes have definite uses in the metal working industries. The plant of the Ford Motor Company uses all kinds of welding in its production work, but resistance welding and particularly flash welding has proved conclusively to be the leader for automobile production purposes.

In order to correct the erroneous idea that this kind of welding is something of a mysterious process, let it be understood that while there are big differences in results between the old-fashioned blacksmith welding and electric resistance flash welding, the similarity is evident. Other forms of welding produce castings at the joint but in the resistance flash welding no metal is added, the original metal only is used, and in heating it has been fully protected from the oxygen and other gases in the air. The upsetting improves the metal just as forging improves metal by refining the grain.

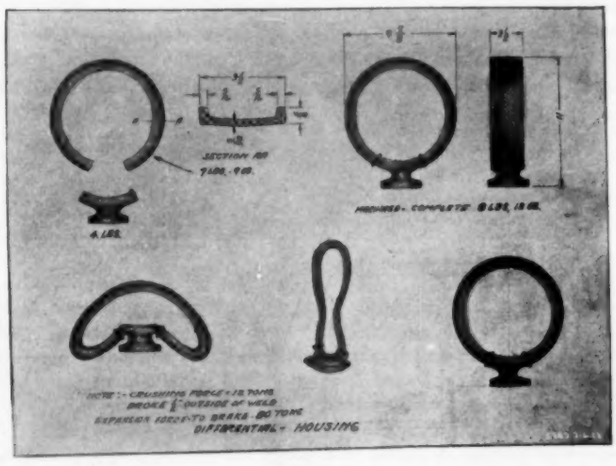


Figure 3.

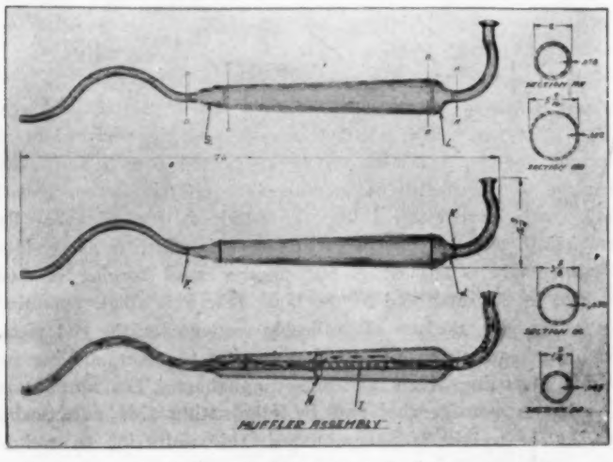


Figure 4.

For the sake of comparison, notice that the blacksmith put his steel in the forge and the heat was applied externally. The steel often absorbed impurities from the heating medium. When at the proper heat it was removed, the surfaces to be joined were cleaned of oxide and placed together and hammered vigorously. The actual welding was accomplished by heat plus pressure.

Now let us see what happens in the resistance flash weld. The heat comes from an arc drawn between the surfaces to be welded. Since it will not heat sufficiently to weld quickly except by reason of the heat of the arc, it is necessary to have the pieces as nearly of uniform section at the weld joint as possible. Copper jaws conduct the current to the piece to be welded and control the heat at the weld, therefore their distance from the weld should be uniform in all directions on each piece. The amount of flash or duration of arcing of the metal is determined by experience. When this is correctly determined there are zones where the metal in the two pieces to be joined, protected from the oxygen and other gases in the air by the arc, have been speedily heated to the correct welding heat from the inside out. The final step is forcing or squeezing the two pieces together very quickly with no loss of time after the proper heat has been reached. The toggle of the machine that forces the pieces together is ready for the squeeze immediately instead of waiting for the piece to be removed from the heating medium as in the case of forge welding, so the joint is made much faster and with much more power than was ever secured in the old hammering process. The squeezing also has the advantage of forcing out the overheated metal and producing a continuous new article of good clean metal.

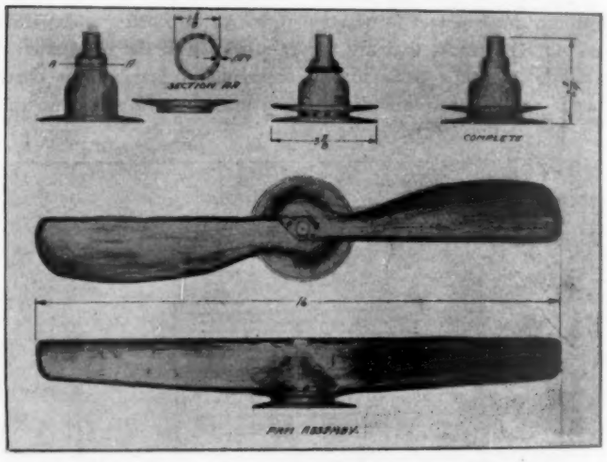


Figure 5.

It is apparent that flash welding can be expressed by the simple formula of heat plus pressure, with the disadvantages of the old blacksmith procedure eliminated. Figure 2 is an illustration of the fundamentals.

A few examples of welded parts in the new Ford cars will show how the perfection of welding processes and welding equipment has made it possible to disregard all former ideas of materials and methods and produce parts of entirely original design.

The differential housing illustrated in Figure 3 is composed of a channel section rolled in our own mills and formed to circular shape in 3 punch press operations. The weight of this piece is 7 pounds 9 ounces. The neck of the housing is a forging made from 3¼ inch diameter bar stock in 3 operations on an Ajax forging machine. After forging it is trimmed and roughly machined ready for welding. It weighs 4 pounds. In the assembly of these two pieces both welds are made at once in an unique machine of Ford design and development which turns out welded housings at the rate of 60 per hour. The finished part after machining weighs 8 pounds 12 ounces. It requires an expansive force of 80 tons or a crushing force of 12 tons to fracture this part and tests have shown that fractures invariably will occur outside the weld.

The muffler, shown in Figure 4, is an ideal example of the kind of production made by combining welding with punch press operations. An outer shell .037 inch thick is blanked from a sheet, formed into a tube and spot welded. The baffle, shown at A, is spot welded in place. The large bell end, blanked and

formed on a punch press, is flash welded to the outer shell. A small bell end, blanked and formed in a punch press, is flash welded to the small end of the outer shell (see "S"). The shell is then assembled through the small bell and center baffle and spot welded to the small end of the bell at "J." The rear end of the center shell is left free to expand with exhaust gases. The inlet pipe is flash welded to the center shell and large bell end at "K." The outlet pipe is flash welded to the small bell end at "F" and that operation completes the muffler. The operations are so simple and the machinery so carefully designed that the welding is actually done in less time than it takes to tell it. The total weight of the muffler is 12 pounds 7 ounces. This muffler does not ring because it is welded into one piece. It has proved to be very efficient in deadening the explosive action with a minimum of back pressure. . The arrows in Figure 4 show the path of the gases.

The construction of the fan is a fine piece of engineering throughout, made possible by welding. The fan is entirely new

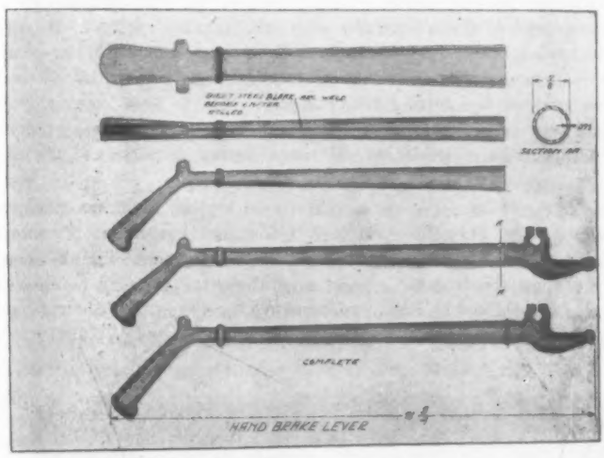


Figure 6.

in design, the design being based on the principle of an airplane propeller whose pitch, lead, weight and balance are figured accurately. The blades are welded around the edge as shown in Figure 5. The fan hub is made on an automatic screw machine and the pulley body is a stamping. They are flash welded together in a machine of Ford design. There is some significance to this last statement because this is in reality a precision job of unusual character for such large production. The run out allowed is only .005 inch. The hub flange is spot welded to the pulley body and the blade is assembled and clamped in place and spot welded. The heavy lines around the edge of the blade in Figure 5 indicate a seam welding operation, the blade being two-walled hollow construction.

The hand brake lever, shown in Figure 6, is made from a stamping which is blanked, formed and arc welded longitudinally. It is then flash welded to a terminal forging as shown in the two bottom portions of the sketch. The pawl rod concealed on the inside of the hollow handle is considered a big improvement over the conventional design which has this rod on the outside. The new design is lighter, neater and stronger. The total weight is 1¼ pounds.

Figure 7 shows the construction of the radiator stay rod. This is made from a strip of steel .036x1$\frac{5}{32}$"x23$\frac{1}{2}$" (weight 4 ounces) rolled into a tube and flash welded to a terminal piece on each end. A special automatic flash welder of Ford design makes both of these welds at one operation. The terminal pieces are made from steel wide upset on a cold heading machine and threaded in a thread roller. The total weight is 6 ounces.

It is readily seen from the variety of the parts described above that welding economies can be realized alike on light material and heavy material. Gasoline tanks are seam welded so as to be gasoline-tight and capable of withstanding air pressure of 90 pounds per square inch. The following parts are also welded: radius rods, four wheel brake parts, seat rests, brake shafts, bumper parts, steering gear cases, tire carrier, battery box supports, wire wheels, torque tubes, frame reinforcements, clutch plates, door frames, window frames, wind shields, accelerator parts, and many other parts. It has been found that in every case the welded design results in the advantages of strength, speed and lightness.

It should not be assumed that this development was a path of roses for the Ford organization. The story of the many obstacles

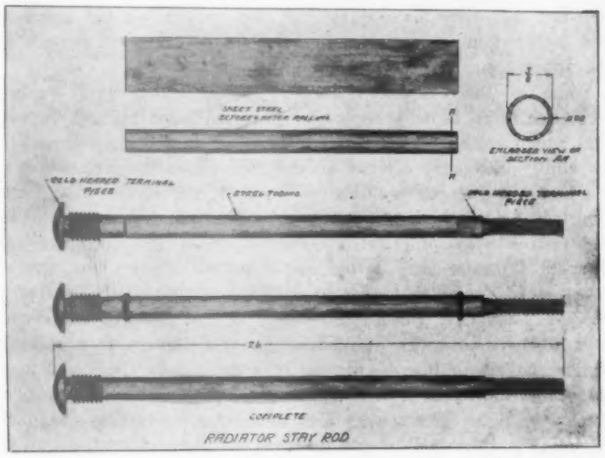


Figure 7.

encountered and mastered in the completing of this new kind of a car (for it is more than a new car) would be received as a wonder tale of modern industry. In many cases machines had to be designed which were radical departures from any existing types of machines; tools and fixtures had to be developed and built to unheard of specifications and operators had to be trained to manipulate them with the proper welding technique. However, the results of all this experiment and research and all this construction of new machinery show that Mr. Ford's conception of the possibilities of welding was correct. It has given the country an entirely new manufacturing process which is revolutionary in character and has proven definitely that whenever welding is judged solely by the old conventional standards of application its possibilities are sure to be tremendously underestimated.

LEHIGH UNIVERSITY HOLDS WELDING SYMPOSIUM

A symposium on welding was held at Lehigh University, Bethlehem, Pa., on April 16. The program included a general discussion upon the "Efficacy of Welding in Repair Work." This discussion included presentations of the subject by the following: A. F. Keogh, President of the Sound Welding Company, New York City; John C. Reed, Bethlehem Steel Company, Steelton, Pa.; J. H. Weiss, Welding Foreman, N. Y. C .R. R., Poughkeepsie, N. Y.

There were shown tests of welded specimens made by the atomic hydrogen arc; the soft iron electrode arc; electronic tornado, spot, automatic (wire electrode) arc; high test steel electrode arc, resistance butt and Thermit welds. There were demonstrations of oxy-acetylene welding, Thermit welding, oxygen lance cutting, atomic hydrogen welding, spot and butt welding and automatic carbon arc welding (two types). There were also laboratory tests of full-sized welded specimens of all types of welding. In the evening Mr. J. B. Green gave an illustrated lecture on "The Flow of Welding Metal."

MANUFACTURERS' EXHIBITS ADD VALUABLE FEATURES TO WELDING CONFERENCE

The several welding conferences which have been held in different sections of the country during the last year, such as those at Universities of Minnesota and Wisconsin, Purdue University and North Texas Agricultural College, have not only provided those who attended with a wealth of usable information on many phases of welding, but have also given the manufacturers of welding equipment an excellent opportunity to cooperate in these efforts to improve the quality of workmanship of welders, and to extend the use of the processes. The manufacturers who have accomplished the most good at these conferences are those who exhibited not only their own wares but also various welded products, and included in their display actual demonstrations of the use of the apparatus.

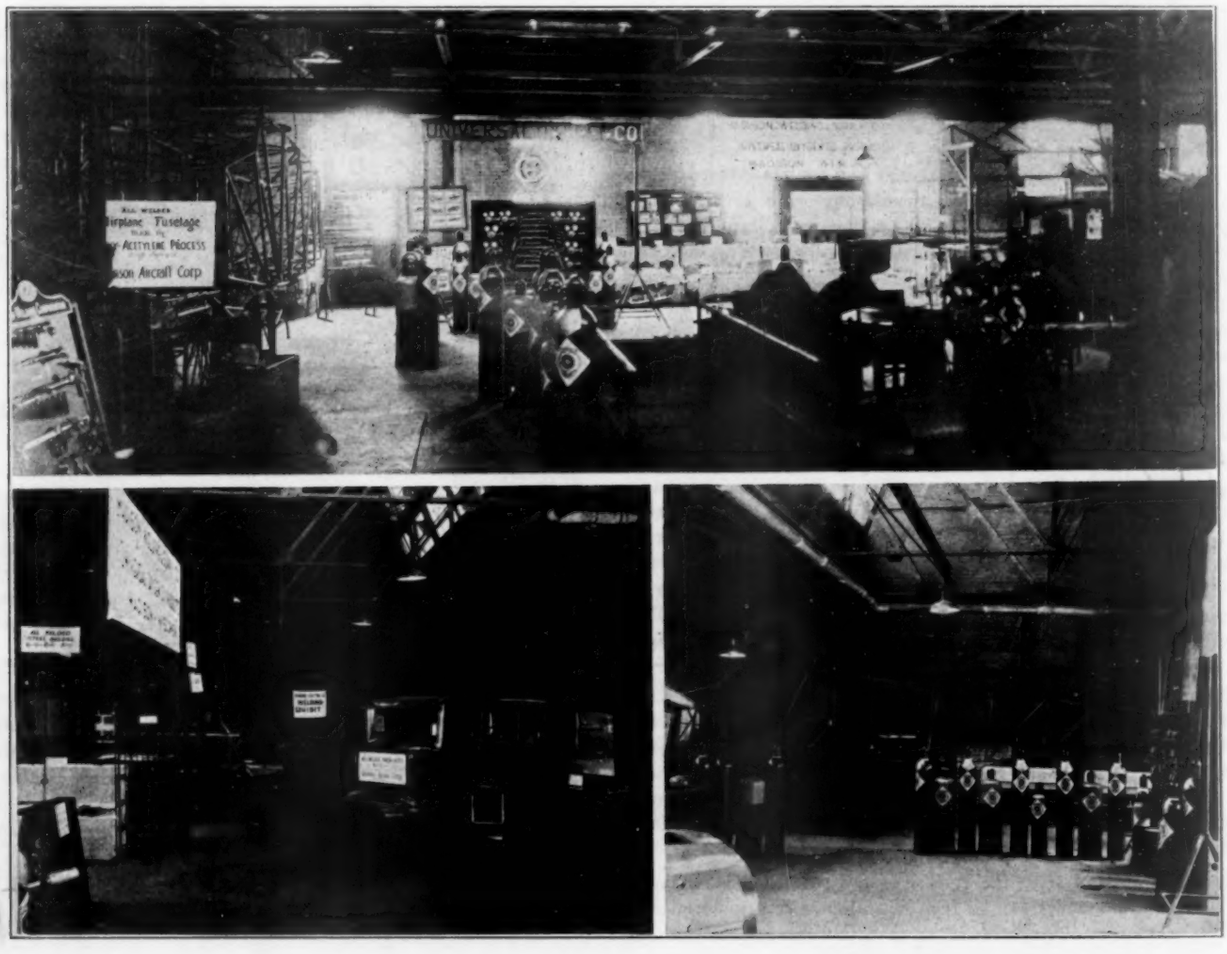
Some of the exhibitors invited questions regarding welding technique from those present and provided some manual instruction which resulted in showing new uses for welding and also in dispelling preconceived ideas on the part of some operators as to the best methods of welding with either the torch or the arc. Constructive work of this nature by the manufacturers supplements in a very practical way the more or less technical and theoretical papers read at the conferences.

One good example of such an exhibit was that of the Universal Oxygen Company, Sheboygan, Wis., at the welding conference held at the University of Wisconsin on February 8, 9 and 10. Figure No. 1 represents the entire exhibit. In the right hand corner is shown a welded steel structure. This building was 9'x10'x12' high. There were also some very interesting specimens of welding furnished by the courtesy of the different manufacturers that do welding in the state of Wisconsin, such as cooking utensils in steel and aluminum and in copper, small tanks, cans for ice cream, small milk cans, airplane fuselage, a sign of the Universal Oxygen Company in which the letters were cut by the oxy-hydrogen process, and a trade mark which was cut by the oxy-acetylene process. The name of Universal Oxygen Company was cut out of a 12" I-beam supported by a welded pipe stand, and illuminated. The trade mark was cut into a $\frac{7}{16}$" steel plate and also illuminated. There were specimens of automobile repair work such as welded cylinders and crank cases. The entire airplane framework was welded out of tubings. In the building sewer lines had been welded and fittings were connected to a lavatory by means of a brazing process. The water line was connected by means of welding and brazing.

Figure No. 2 shows part of the building. In the left hand corner was a welded gate and window made by Emil Lehmann, an art smith of Milwaukee. A machine base welded from sheet metal is at the left in Figure No. 2, and an automobile body furnished by the Seaman Body Co. showed what could be done by the oxy-acetylene process by welding the seams on the body. The Simmons Company, Kenosha, furnished all steel welded and brazed furniture, which represented a complete bed room suite.

Figure No. 3 represents another view of the exhibit, which was placed in the blacksmith shop and foundry of the University Mechanical Department. In the front part was held the practical demonstration of welding and cutting. Particular interest was created by cutting heavy metals 12", 14", 16" and 18" in thickness with both the oxy-hydrogen and oxy-acetylene process. These cuts were made several times during each day of the exhibit.

Other exhibitors were several oxy-acetylene welding concerns such as the Oxweld Acetylene Company, Linde Air Products Company, Smith Welding Equipment Corporation, The Wisconsin Oxygen-Hydrogen Co., and several electric welding companies such as the Lincoln Electric Company, the General Electric Company, C. H. Hollup Corporation, and the Fusion Welding Corporation.



Training Men for Gas Welding*

Some Sidelights on the Difficulties Encountered in Obtaining Real Good Welding Operators and Methods of Training Men in Preparation for Particular Work

By M. C. Stone†

IN the training of men for industry one is likely to think that where a successful method is worked out in one line, it may be used with equal success in others. While this is true to a certain extent, it may lead to trouble before one realizes it.

One of the primary requisites in welding is the physical strength to do the labor required, which is quite heavy. Another one, and of still greater importance, is the co-ordination between mind and muscle that gives a man perfect control over his movements. A mechanical inclination, though valuable, is not necessary. Previous experience is sometimes a detriment rather than an asset though this is not necessarily always true. Despite the common belief to the contrary, very few people have eyes that will not stand the strain imposed upon them by welding. Most of the trouble is caused from reflected heat rather than from light rays. Any one not taking the necessary precautions is likely to suffer temporary or even permanent injury to his eyes. Any man who will not take these precautions is a potential liability to his company and will sooner or later come to grief and cause his employer loss by visual impairment from his carelessness. Negligence of this sort is inexcusable. No trade can afford to tolerate it.

One of the greatest weaknesses in the training of men for welding is the fact that so few people realize the difficulty of becoming skilled welders and supervisors of welding. The operation looks so easy while observing a welder at work that the novice often gets the idea that with only a few days training he can acquire sufficient knowledge and skill to hold a job. Unfortunately in many cases this is also true of the supervising engineer who is not skilled in the art himself. He may under-estimate the natural ability required to learn this trade and take his best men for other operations. Then he wonders why he has not the kind of welders he needs, and why his welds are not satisfactory. Consequently he too often condemns the process or the equipment. Only a few days ago a manufacturer told me that welding was unsatisfactory in their shops as a method of repair on automobile work. He said his own force had no success with it and that in taking work outside he practically failed on many jobs on cast iron because of warping or locked-up strains. When asked about bronze welding cast, he said it was an absolute failure and couldn't be done, wouldn't hold. Another manufacturer, remarking upon his lack of good welders, when asked about certain men in his employment, said "Oh, no, I can't keep them in the welding department because they learn too readily. I must use them somewhere else." By employing one of these men as supervisor of welding, he would change this department from a necessary liability to a paying proposition.

Welders themselves, forgetting some of the trials they had and the time they spent in observing and acquiring their ability, are inclined to under-estimate the difficulty of training a welder. They remark to their friends that there is nothing to it, a man should learn to weld in two weeks at least. Yet it is surprising and humiliating to many welders, who have been in the game for years, when they go to the pipe lines for employment and fail to stick. I have personally talked to a number of these men who were very much mystified upon finding that the metal wouldn't do as it should. They could very easily have prepared themselves if they had not under-estimated the knowledge and skill necessary for successful pipe welding. On the other hand, the pipe line welder sometimes tells you that there is nothing to it, very easy. It is exceedingly so if you know how.

Last but not least, many of the salesmen who are selling welding equipment know very little about welding, further than that their equipment will perform satisfactorily in the hands of skilled operators. Observing the apparent ease with which the welder does his work, the salesman decides that anything which looks so easy can be acquired in only a few hours by any mechanic. Instead of trying it himself, he sells equipment on this assumption and the buyer has trouble, turns out bad jobs and if he continues using the equipment very often brings condemnation upon the process. I recommend that you ask these salesmen who assure you that their equipment or material will do so and so to show you how it is done.

We follow no set rule in our training at the North Texas Agricultural College, but work with the individual, trying to pick out his shortcomings and, by all the means at our command, endeavoring to cure them. One man will find trouble with one thing, and another with something else, but all of them have trouble in keeping a torch in proper adjustment. One may desire a neutral flame, but how many neutral flames can he get out of one tip? The experienced man controls his adjustment unconsciously, but for the novice it is a real problem. As soon as a man is able to adjust his torch and keep it adjusted reasonably well, we immediately notice an improvement in his work.

The general plan which we follow is to work with all the men in a group for a few days to help them adjust themselves to the new conditions. One of the first lessons is how to get a flame started without damage to the equipment. We believe that care in handling the equipment is at least half the game. No man can do a worthwhile job without good tools in perfect condition. Care and understanding of equipment inspires confidence in the worker. We tell him why he does a certain thing and what happens when he does this.

During the first days of the course we have the boy work on light steel plate. In this way he has no trouble in burning in, not caring what kind of welding results we get. After the student finds himself we try for a ripple on plate, first in a horizontal position, then at various angles. As soon as a fair ripple is obtained, we try joining plates. From this we pass on further into steel welding. From there on it is largely a matter of individual practice.

A man advances as fast as he is able. Our pipe line course is limited to plate and pipe but our job shop course calls for cast iron welding, brazing, and bronze welding of cast iron. Aluminum comes last, not because we think it the most difficult metal to weld, but because it takes more preparation and more careful judgement as to heating.

After the boy acquires the control of metal and is able

Paper read before Welding Conference at North Texas Agricultural College, Arlington, Texas.

†Welding Department, North Texas Agricultural College.

to make a weld on mild steel and cast iron he must then begin to study the metal itself. Modern production has given us many varieties of metal and each is affected differently by heat and must be welded accordingly. Of course, mild steel and malleable and grey cast iron will continue to make up the bulk of our welding, but we must remember that success depends upon one's ability to do the exceptional job rather than the one anybody can do. The problems of expansion and contraction cause a great deal more trouble than the actual application of the weld. The welding department that is under an experienced supervisor, one who is able to handle all layout details, to decide just how and with what material and equipment a job is to be done, may be successful while employing only medium grade workers. This supervision work is worthy of the best brains in any industry, and until this is recognized and paid for the welding process as a method of repair or manufacture must continue to suffer.

In summing up, I will say that with our well-equipped shops, for which we are indebted to these jobbers and manufacturers who have loaned us the equipment for instructional purposes, we have found that it takes an average of five weeks to train a man to apply metal to the point of commercial success. We have had a number of exceptionally good men, two trained engineers among them, and none of these men were able to obtain any startling results in less than four weeks. This certainly is not caused by lack of practice, as any of these men will tell you if you talk to them. Some of them might have held a job before leaving us, but we are not satisfied to turn out the type of man who can barely hold a job. It is the purpose of our instruction to make a real contribution to the welding industry. Welding as a trade has a good future for the one who is willing to put his very best efforts into it and tackle it as a man-sized job.

FORTY-FIVE MILE HIGH PRESSURE PIPE LINE FABRICATED ENTIRELY BY ELECTRIC ARC WELDING

Recently, an electric arc welded pipe line extending from Lamkin, La., to Hodge, La., a distance of forty-five miles, was successfully completed. It is 7" in diameter throughout the entire run and carries from 600 to 1,000 pounds pressure. The line was welded by The Big Three Welding and Equipment Company of Houston, Texas. This Company, under the direction of Mr. B. K. Smith, its president, has been engaged in diversified welding aimost since the commercial development of electric arc fusion welding was begun. For several years prior to the building of the line from Lamkin to Hodge, Mr. Smith had been working experimentally on pipe line welding with the thought in mind that some day he would be called on or permitted to construct a line in that fashion.

The country over which the line ran was very rugged and broken. There were hills, deep ravines, woodlands and swamps. There was even a river to cross. Despite these physical obstacles the line was laid without difficulty. A total of five gas engine driven Lincoln "Stable-Arc" were used. In doing the work in the field, the welders, of course, operated as a team; that is, four men simultaneously welded four consecutive joints and moved on. The lengths thus formed were joined togethr by a bell hole operator.

The line was built in five mile stages, each stage being finished and tested under hydrostatic or gas pressure before further pipe was laid. The joints were lap welds, one end of each length of pipe fitting inside a bell on the end of the next length and all were made in two layers. It is interesting to note that with this construction, which was developed by Mr. Smith, but 14 pin holes occurred in 11,000 joints.

On December 15, 1927, the pipe line was finished and in the ditch. From Lamkin to Hodge it stretched as a solid gas artery. It had been tested and accepted and there only remained the work of covering it over. Two weeks later when about 20 miles still lay exposed in the trench the line was subjected to one of the severest imaginable tests. On January 1, 1928, a northwestern storm swept Louisiana and the temperature dropped to six above zero. Everyone thought that the line would break somewhere under contraction stress, but nothing happened and

Welding 7-inch Pipe in the Field.

there was no sign of failure in all twenty miles. It had always been the belief of pipe line men that line built during warm weather would break if left exposed to bitter cold of a winter blizzard. In the past, with mechanically fabricated line, the belief has been justified but the new arc welded line showed no sign of rupture upon exposure to the lowest temperature that Louisiana has known in thirty years.

USES AIR EXPRESS TO DELIVER WELDING EQUIPMENT TO AIRPLANE CO.

"Speed" Holman waved, a mechanic pulled the blocks and the first air express plane left Minneapolis on its maiden trip to Chicago.

In this first cargo was a New Smith's No. 7 airplane welding torch, shipped by the Smith Welding Equipment Corporation of Minneapolis to the Smith Welding Equipment Eastern Corporaton of Philadelphia. The torch left Minneapolis at 2:30 P. M. on Tuesday and was delivered in Philadelphia before noon the next day.

Upon receipt in Philadelphia, it was immediately iorwarded to the Kreider-Reisner Aircraft Co. of Hagerstown, Maryland, where it is to be used for welding fusilages and other metal parts on the planes that this organization produces.

TWO OF OUR CHICAGO FRIENDS CELEBRATE MOVING DAY

For many years May first has been recognized as almost a city holiday in the city of Chicago because it is one of the two days in the year when thousands of leases expire and new leases begin. This year the day will be celebrated by the Gas Products Association and by Joseph Halla, representative of the National Gauge and Equipment Company for the states of Illinois, Indiana, Wisconsin, Minnesota and Missouri. Both have had offices for some time at 140 S. Dearborn Street and are moving to the thirty-first floor of 333 N. Michigan Avenue, one of the finest of Chicago's new sky scrapers. Notice has been received that both the Association office and Mr. Halla's office will be moved and ready for company on May first.

Practical Studies of Electrodes*

Various Factors Which Determine the Suitability of a Metallic Electrode from the Standpoint of Weld Quality and Flowing Characters

by Kenneth R. Hare†

PART II

IN ORDER to still further show the importance of composition as affecting the characteristics of electrodes, we will briefly list the impurities ordinarily found in electrodes of the more common grades, indicating the effect of each. We will also list the alloys most commonly used, briefly describing their peculiar characteristics.

The chemical elements, besides iron, always found in commercial grades of iron and steel, as used for welding rods, are as follows:

Carbon
Manganese
Phosphorus
Sulphur
Silicon

Commercial iron and steel also generally contain some occluded gases, principally hydrogen, nitrogen and carbon monoxide, but these will not be referred to again, as their effect has already been mentioned.

Carbon

Carbon is the most important element to be controlled in commercial steel, even including the very low carbon, or so-called iron electrode. It is the carbon content that distinguishes steel from wrought iron or cast iron. The more common electrodes are generally graded according to their carbon content, as follows:

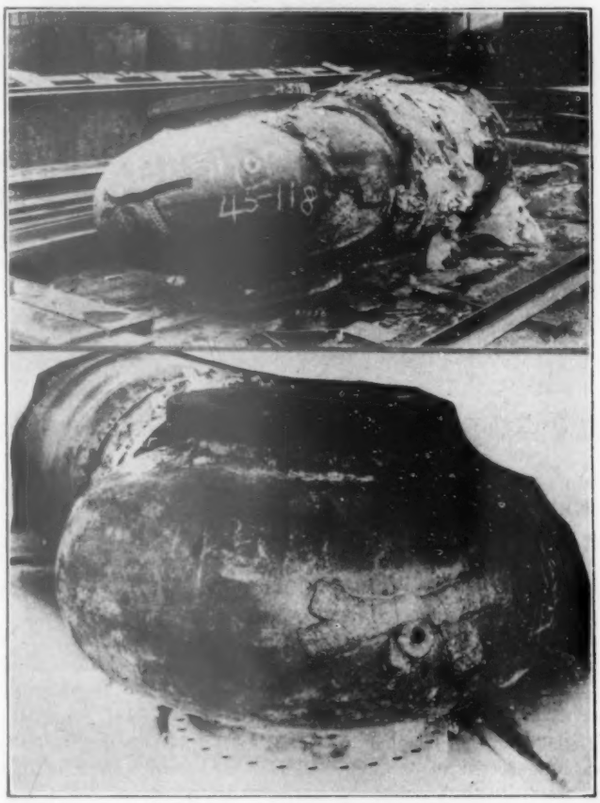
Low Carbon Iron or Steel	**Carbon not over 0.06**
Mild Steel	**Carbon 0.06 to .20**
Medium Carbon Steel	**Carbon .20 to .60**
High Carbon Steel—Grade "A"	**Carbon .60 to .85**
Grade "B"	**Carbon .85 to 1.10**

In general, it may be said that the tensile strength of a weld varies directly with its carbon content and that the ductility varies inversely with the carbon content. The first two of the above grades, namely the Low Carbon Iron and the Mild Steel, may be used interchangeably under ordinary circumstances, depending upon the preference of the operator. Either of these grades, if they have the proper flowing characteristics, will produce sound welds on structural steel, boiler plates, tank steel, low carbon steel castings, etc., and will, in general, prove satisfactory. The commercially pure iron will give a slight increase in ductility but in general the higher tensile strength produced by the mild steel would favor its use. The iron electrodes should, in the hands of an experienced operator, produce welds which average about 45,000 pounds per square inch, while the mild steel electrode should produce welds averaging about 55,000 pounds per square inch.

The next grade, medium carbon steel, will produce welds averaging about 60,000 pounds per square inch with very little sacrifice in ductility. The deposit from this electrode will be somewhat harder than produced by the previous two grades but at the same time will be equally machinable, so that this is the grade that should be used for building up shafting and other worn parts which must later be machined and which are used as bearing surfaces. This grade should also be used for welding medium carbon steel castings. The high carbon steel is used almost exclusively to build up parts subject to abrasion. Its deposit is not machinable, except when annealed and such rods should not be used where ductility or resistance to shock is important.

Manganese

All commercial grades of steel contain manganese from a trace up to 20 per cent. When occurring in small quantities it will probably be found largely in combination with the sulphur present, thus counteracting, to a certain extent, the harmful influence of that element. The presence of small



Above—Crack in Large Cast Iron Steam Separator, Prepared for Welding. Below—Separator Repaired by Electric Arc Welding.

quantities of manganese also helps to keep the electrode itself and the deposit free from oxides. The addition of from 10 to 20 per cent manganese in the steel, together with 0.85 to 1.25 carbon creates an alloy steel having very special qualities which will be discussed later.

Sulphur

Commercial steel can contain up to from 0.01 to 0.10 per cent sulphur, but this impurity is generally present in quantities of 0.01 to 0.05 per cent. Most electrode specifications specify not over 0.04 per cent. The effect of sulphur, in excessive quantities is to cause brittleness and weakness in the steel, particularly at the higher temperatures. The common term for this condition is "hot shortness." As far as welding is concerned, the worst effect of sulphur is its liability to cause cracks in castings or in a weld during cooling.

**A paper delivered before the University of Wisconsin Welding Conference, Madison, Wis., Feb. 8, 9 and 10, 1928.*

†Sales Manager, C. H. Hollup Corporation, Chicago.

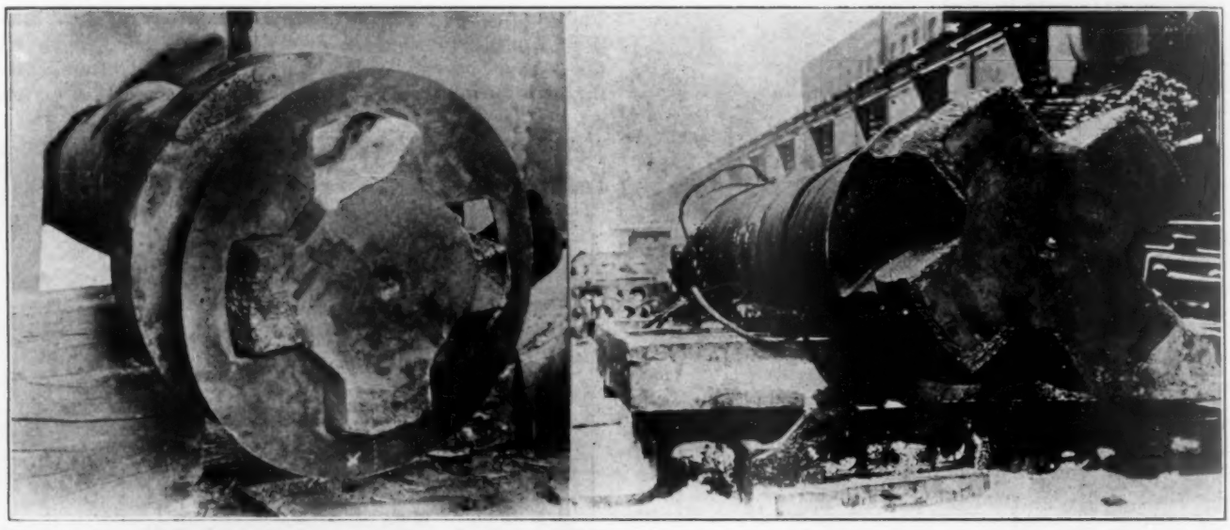
Phosphorus

Phosphorus is generally present in commercial steel in approximately the same quantity as sulphur, namely from 0.01 to 0.05 per cent, and like sulphur it is generally specified not to exceed 0.04 per cent. The effect of phosphorus is somewhat like sulphur in that it produces brittleness even when the steel is cold. The brittleness caused by phosphorus is of the kind particularly subject to rupture under vibratory stress or sudden shock.

Silicon

Silicon is generally specified to be present in commercial welding rods of iron or steel in quantities up to 0.08 per cent. It is considered that silicon has a beneficial effect in the case of welding deposits due to the fact that it helps to produce a sound weld free from blow holes.

on the surface. The heat treatment of manganese steel is very important because it is extremely brittle when allowed to cool slowly but if it is cooled suddenly by depositing on a heavy mass of steel or by quenching with water, it becomes very tough. Small quantities of manganese in steel of between 4.0 and 7.0 per cent produce a steel that is extremely brittle. This is why it is necessary to have the manganese content in the welding rod at approximately 12.0 to 14.0 per cent. The study of manganese steel is very interesting and to those who have occasion to use it a great deal we would recommend reading up on the subject so as to become thoroughly familiar with its characteristics. Those that do this will derive full advantage from the peculiar qualities of this steel and it will greatly assist them in their welding applications.



Left—Steel Wobbler Which Has Been Three Quarters Repaired by Building Up With High Manganese Electrodes. Note Wear on Upper Tooth. Right—Steel Wobbler After Building Up With High Manganese Electrodes.

We now come to the elements generally added to steel to produce common alloy steel electrodes. These are:

Nickel
Vanadium
Manganese
Chromium

Nickel and Vanadium

Nickel steel for commercial purposes, generally contains from 1.50 to 4.50 per cent nickel and from 0.20 to 0.50 per cent carbon. The chief advantage of nickel steel over carbon steel is its higher elastic limit, which is obtained with only a slight decrease in ductility. This same characteristic is also true for vanadium where present in quantities of from 0.10 to 0.30 per cent. It has been our experience that vanadium alloys seem to be a little more satisfactory as electrodes that the nickel alloys, whereas in the oxy-acetylene welding process, the nickel alloys are very successful.

Manganese

Commercial high manganese steel castings are generally used for crossings and frogs by railroads; for parts of machinery subject to great abrasion, etc. It usually contains about 12.0 to 14.0 per cent manganese and 1.25 to 2.00 per cent carbon. High manganese steel of this composition has great strength and ductility. This alloy may also be made extremely hard by proper mechanical working as well as extreme hardness. In the case of a manganese frog, this is accomplished by the rolling of the car wheels over it and in the case of steam shovel dipper teeth, etc., it is accomplished by the action of the stones and pieces of gravel against the metal. This fact explains why a deposit of manganese steel can apparently be peened out with a hammer. This peening, however, cannot be done indefinitely. It can only be done

Chromium

The introduction of chromium in steel produces an alloy of great hardness and some alloy of chromium is generally used where maximum resistance to abrasion is desired. There is, in fact, some difference in opinion as to whether a chrome steel or a high manganese steel gives best results in certain cases. There is one large city in Wisconsin that is using a chrome nickel steel for its frogs and crossings in street railway work, believing that this steel gives better results than cast manganese. It has been our experience that when building up excavating machinery parts, such as dipper teeth, the edges of clam shell buckets, etc., that a chrome alloy generally produces better results than when building up with manganese. We believe that this would be true except when the excavating was of very heavy gravel and coarse sand. It is undoubtedly true that a chrome alloy, applied to excavating machinery parts seems to give better results when excavating soft dirt. Manganese steel, in this case would not get the hard impact from rocks, gravel, etc., that is necessary to bring out its maximum hardness. Commercial chrome steel generally contains from 1.0 to 2.0 per cent chromium and 0.80 to 2.0 per cent carbon and because the element chromium affects the critical changes in steel, deposits made by chrome alloys are to a certain extent self-hardening. This hardening, however, can be further improved by heat treatment. Chrome alloys have the quality of toughness, also, and for that reason are preferred for building up steel rails where the rolling and battering of the wheels on the rail produces a service that is too severe for deposits from ordinary high carbon steel electrodes. We do not recommend welding chrome vanadium direct to high manganese, however. In cases where a layer

of chrome alloy is desired, on a manganese casting, we would recommend first laying down at least a one-quarter inch layer of ordinary mild steel, which should be water quenched, except on heavy sections; then the chrome alloy may be laid down on the mild steel layer without water quenching. This method will preserve the quality of the original manganese casting for reasons already mentioned.

Special Alloys

There have been placed on the market in recent years, several special alloys for use as welding rods, including stellite and kinite, which are special alloys of chromium, cobalt, molybdenum or taupten and which may not contain any iron at all. These alloys may be used either by the electric or oxy-acetylene process and have a very definite field of usefulness. They deposit a metal having the greatest Brinell hardness that has yet been obtained by welding. There are also some synthetic electrodes now available where the alloy elements are introduced in the form of a flux containing ferrochrome, etc. These electrodes are giving exceptionally good results. In one case an electrode has been developed consisting of two parts, a solid high carbon steel core and an outside sheet of chrome steel, low in carbon. By this method the resulting deposit is a high carbon chrome alloy having any desired proportion of the alloying elements. The result is naturally a deposit of great hardness, although not as hard as the stellite or kinite, above referred to. The introduction of the alloying element into the weld is at a uniform rate and therefore produces a deposit of uniform composition.

We shall now give in tabular form, the average analyses of the more common grades of electrodes indicating the average physical properties as regards tensile strength and Brinell hardness that may be expected from the deposit made by them.

With each of the different grades of electrodes listed in the following table, we shall also indicate by explanatory note any special procedure or technique in the welding operation that may be necessary to obtain the best results.

In connection with the more common electrodes, we have indicated not only the analysis of the rod itself, but also the analysis of the deposit as obtained by either the bare or flux coated types. A careful study of this information should enable the purchaser of electrode materials to determine what grade and what type best meets his requirements.

Appended to this paper will also be found a recommended table of electric current values as recommended for the different sizes and different grades of the more common electrodes. This table is of necessity one of general averages because the voltage and current is dependent on so many different factors. Among these are: the type of welding machine, thickness of the plate welded upon, the temperature of the piece welded on and whether or not the electrode is flux coated. It is generally true that flux coated electrodes take less voltage for the same penetration than the bare electrodes. The safest way to determine the best machine setting for any given welding condition is by actual trial, making such adjustments as may be desirable until the proper results are obtained. A rule that is practical and easy to remember is to adjust the current to a value equal to the mill diameter of the electrode or its diameter in thousands of an inch.

I—COMMERCIALLY PURE IRON

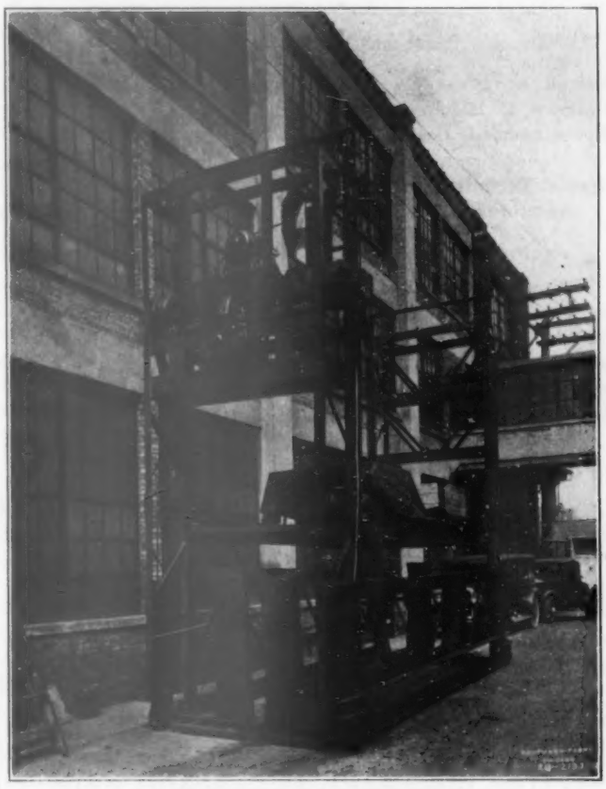
		By Test		
Element	Average Specification	Rod	Bare	Deposit Coated
Carbon	Not over 0.06	0.03	0.02	0.03
Manganese	Not over 0.15	0.09	0.09	0.11
Phosphorus	Not over 0.04	0.007	0.013	0.013
Sulphur	Not over 0.04	0.035	0.043	0.041
Silicon	Not over 0.08	0.01	0.01	0.01

Average Tensile Strength per sq. in.....45,000 to 50,000 lbs.
Polarity of Electrode.....negative
Recommended Uses.....General welding of boiler plate, structural steel, tank steel, etc.
Special Technique.....None

II—LOW CARBON OR MILD STEEL

		By Test		
Element	Average Specification	Rod	Bare	Deposit Coated
Carbon	0.13-0.18	0.13	0.03	0.03
Manganese	0.40-0.60	0.44	0.16	0.28
Phosphorus	0.04	0.018	0.019	0.022
Sulphur	0.04	0.031	0.036	0.038
Silicon	0.06	0.01	0.01	0.01

Average Tensile Strength per sq. in.....50,000 to 55,000 lbs.
Polarity of Electrode.....Negative
Recommended Uses.....General welding of boiler plate, structural steel, tank steel, low carbon steel castings, etc.
Special Technique.....None



All-Welded Two-Story Elevator.

III—MEDIUM CARBON STEEL

		By Test		
Element	Average Specification	Rod	Bare	Deposit Coated
Carbon	0.35-0.45	0.39	0.15	0.24
Manganese	0.30-0.60	1.08	0.40	0.39
Phosphorus	0.04	0.011	0.014	0.014
Sulphur	0.04	0.031	0.034	0.035
Silicon	0.12	0.15	0.07	0.06

Average Tensile Strength per sq in.....55,000 to 60,000 lbs.
Brinell Hardness.....143
Polarity of Electrode.....Negative
Recommended Uses.....Building up of worn steel bearings, axles, etc.; welding of medium carbon steel castings.
Special Technique.....None

IV—HIGH CARBON STEEL—GRADE "A"

Element	Average Specification	By Test Rod	Bare	Deposit Coated
Carbon	0.60-0.75	0.65	0.24	0.39
Manganese	0.60-0.90	0.68	0.46	0.55
Phosphorus	Not over 0.04	0.011	0.012	0.012
Sulphur	Not over 0.04	0.029	0.037	0.035
Silicon	0.20	0.16	0.02	0.05

Brinell Hardness.....149
Polarity of Electrode.....Positive
Recommended Uses.....Building up only on steel parts subject to medium abrasion.
Special Technique.....Slightly preheat part welded on for best results.

V—HIGH MANGANESE STEEL

Element	Average Specifications	By Test Rod	Deposit Coated
Carbon	1.10-1.35	0.99	0.71
Manganese	11.00-14.00	10.51	10.19
Phosphorus	0.017-0.04	0.043	0.061
Sulphur	0.007-0.04	0.022	0.018
Silicon	0.10-0.20	Not det.	Not det.

Brinell Hardness.....228
Polarity of Electrode.....Positive
Recommended Uses.....Building up worn surfaces of high manganese castings only.
Special Technique.....Deposit in wide, short beads. Thoroughly peen and then water quench the deposit from each electrode.

VI—SPECIAL ELECTRODES

Following is a list of special electrodes whose desposits are extremely hard, showing the Brinell hardness for each.

Stellite (Grade 1).....Brinell Test 652
Stoodite (Hollup Grade A).....Brinell Test 600
Hollup No. 170.....Brinell Test 302
Stoody (Hollup Grade B).....Brinell Test 572

TABLE OF ELECTRODE SIZES AND CURRENT VALUES

Diam. of Electrode Fractions of an in.	Thousandths of an in.	Recommended current values
3/32"	94	40- 90
1/8"	125	75-150
5/32"	156	125-175
3/16"	188	175-200
1/4"	250	200-275
5/16"	312	275-350
3/8"	375	350-400

CUTTING DISCUSSED AT CHICAGO MEETING

At the April meeting of the American Welding Society, Chicago Section, which was held Friday evening April 6th, Mr. Fred Maeurer of the Air Reduction Sales Company, presented a paper entitled "Factors Involved in Economical Gas Cutting." The paper pointed out the necessity for good supervision over cutting operations and gave concrete examples of methods used to reduce cutting costs in places where a number of oxy-acetylene cutters were employed. The paper was followed by a lively discussion of special points brought out in the paper.

BOILERMAKERS TO MEET IN MAY

The annual meeting of the Boilermakers Supply Men's Association will be held this year at the Hollenden Hotel, Cleveland, Ohio, May 22-25, inclusive. The meetings of the Master Boilermakers' Association are to be held in the meeting room in the same hotel, adjacent to the exhibit room.

WELDING IN MEXICO

A report of present conditions, indicating that the United States must export welding talent before it can sell welding equipment.

By J. B. Green*

I have just returned from a vacation of several weeks spent in Mexico, and found much interest there in fusion welding. I learned that welding rods, oxygen and acetylene are manufactured in Mexico but nearly everything else is imported.

Nearly every large company has at least one arc welder and there is some gas welding. Managers and engineers, for the most part Americans who have lived in Mexico for ten to twenty years, are keenly interested in extending the use of welding in their shops. For some reason, which I was unable to determine, they refused to enthuse over any process except metallic arc welding. For the most part, the men I met were directing very large enterprises. They possessed all the intelligence and business ability that men must have in similar positions in this country. They all directed their efforts toward impressing me that Mexican metal making and using industries are not in such great need of welding equipment and supplies as trained welding engineers. Few Americans have gone to Mexico to live during the last fifteen years and so Mexican management had its American technical training before welding became so highly developed and universally practical. It hears almost daily of the results obtained by welding in the United States and has no prejudice against purchasing welded articles but almost completely lacks the trained men to even start to obtain similar results in Mexico. Working welders are not needed. Plenty of Mexicans are available at about half American wages who quickly learn to handle an arc and who can manipulate according to their instruction fully as skillfully as the best American operator. Men are wanted who understand what can be successfully arc welded and how, who know procedure control, who know something about redesign for welding, in short welding engineers. To such men, Mexican industry will pay higher salaries than apply in the United States.

Living conditions are quite different in Mexico and should be carefully investigated before a trip is made. Vaccination is compulsory for admission to the Republic and innoculation against typhoid and pneumonia should not be neglected. Most of Mexico is a mile or more above sea level so it is not a place for those whose hearts are affected by altitude. The climate is delightful, rivaling if not surpassing, as an all year proposition, that of the Riviera. Food is not always as clean as Americans are accustomed to but it is usually very tasty and in the better eating places in the larger cities it can generally be relied upon. For Americans resident in Mexico, food and drink are under their own control and they may set their own standards. There are approximately fifteen million people in Mexico out of which twelve million are illiterate peons. Banditry is always "news" for the press but, with the exception of a very few small bands it has practically been wiped out. The people are naturally hospitable and the government has for some time been fostering a special spirit of friendship for Americans. Colonel Lindbergh's visit put on the finishing touches. Rich and poor alike grasped its significance and there is now a very noticeable effort on the part of all Mexicans to make Americans feel welcome. A sincere desire for a sympathetic understanding of Mexico and the Mexicans is really all an American needs to insure a very cordial reception. A knowledge of Spanish is desirable but by no means necessary. Nearly everyone picks it up almost unconsciously although a few Americans have lived in Mexico for years, prospered in business, and have yet to learn their first words of Spanish.

I was repeatedly approached by managers asking if I knew

*President, Fusion Welding Corp., Chicago.

of competent welding engineers between the ages of 28 and 35 years who might be induced to go to Mexico. Men over 35 years old going to Mexico to earn their living probably should provide their own capital but for the younger man who is capable, who has the ability to keep sober and work hard, there appear to be many opportunities to earn more and live better at a lower cost than in the United States.

The application of welding in Mexico has not progressed and probably never will to the point it has reached here. I have in mind particularly what we call "production welding." Some such welding is done in Mexico and more will be, but the country will never in this generation become a nation of manufacturers. The minerals in the earth and the products of the soil together with providing the men who mine and farm with part of their facilities and requirements are the sources of Mexican income. Welding, therefore, is more a matter of repair and salvage with only a small amount of construction work. Opportunity for the welding engineer lies among the railroad shops, the tramways, the steel works and foundries, the oil refineries, the mines and smelters, etc. There are some enormous enterprises of this kind in Mexico with invested capital as high as a hundred million dollars per company. These companies are aggressively in the market for American welding talent, not of the consulting professional sort but of the man who goes to Mexico in their employ and in the beginning possibly devotes only a few hours a day to welding and the rest of the time to related engineering work. If they succeed in purchasing enough of such talent they will then look to the United States for much of the required welding equipment and supplies.

OVERCOMING ARC BLOW

In some types of arc welding operations welders are apt to have difficulty with what many of them term as "arc blow." This is a condition which is generally considered to be caused by a magnetic disturbance in the neighborhood of the arc. On some jobs the effect becomes so pronounced that the welder has great difficulty in making his metal deposit smoothly. It is not always possible to determine just

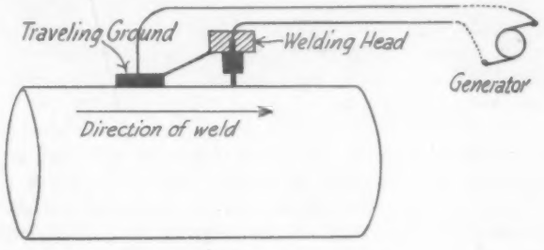


Figure 1

what is the best way to get around this condition and make the arc perform properly, but the accompanying sketches show some of the devices which have been used to solve the problem in specific instances. One class of work on which this arc blow has given trouble is automatic metallic arc welding of longitudinal seams on tanks. A few methods of correcting it are indicated in Fig. 1 and 2. Fig. 1 illustrates the principle of arranging the ground so that it will travel along close behind the automatic welding head while the latter travels the full length of the seam. Fig. 2 illustrates the use of a railroad rail which has been machined out to hold a copper back strip. Besides serving as a heat conductor this copper bar serves also to deflect the magnetic field and by placing the ground in the position shown in the drawing it is often possible to get entirely rid of the erratic arc. Inexperienced arc welders are also apt to encounter a wild arc when attemping circumferential welds on large diameter pipe and Fig. 3 shows a method of reducing the difficulty. Here it is simply a matter of taking a couple of turns of the ground cable around the pipe before applying the ground. In case not much improvement is noticed it will probably be helpful to reverse the direction of the winding of the two turns of ground cable. Fig. 4 illustrates two things which are done to overcome arc blow in connection with the automatic metallic arc welding of spiral seams

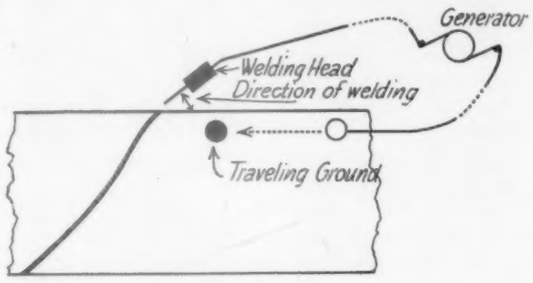


Figure 2

around the pipe. In this case not only is there a movable ground which follows the head but the welding head itself is tilted at a rather sharp angle. This position of the electrode seems to be very effective in quieting the action of the arc. There are other classes of work in which this difficulty may be encountered and it is not possible to lay down general

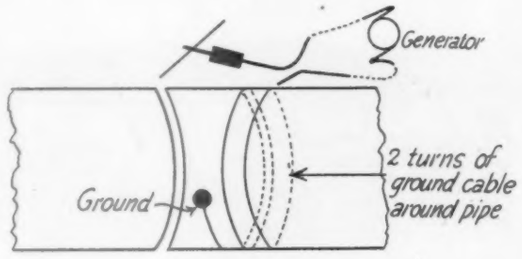


Figure 3

rules as each case has to be solved by trial. However the devices shown here may prove useful in suggesting methods of approaching the problem in special cases.

Two more interesting experiences with arc blow may be worth while mentioning here. One is a case of a welder doing his first job on a steel structure and finding that in a number of cases the arc gave him quite a bit of trouble in the corners. He adopted the procedure of taking a couple of turns around a steel member with the ground wire and after a little bit of experiment was

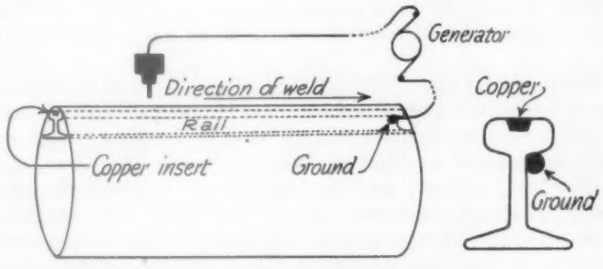


Figure 4

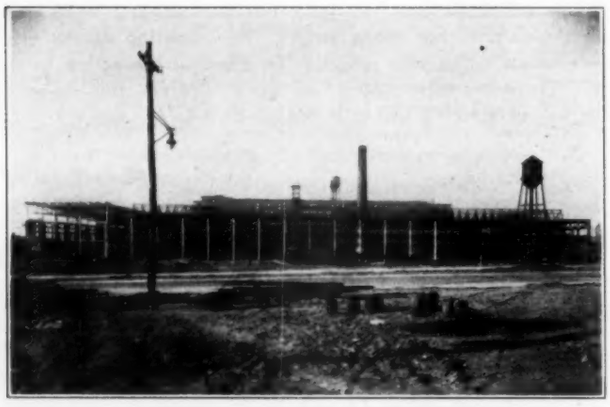
able to correct arc blow in practically all cases. Another operator found that in welding long seams in tanks he experienced no trouble at the beginning of the seam but considerable trouble when he reached about the middle of the tank. He overcame the difficulty by making up a ground which extended the full length of the seam.

GENERAL ELECTRIC WELDS BUILDING

A new steel frame factory building, welded instead of riveted, is being erected by the General Electric Company at its new plant in Philadelphia. This building, the framework of which is completed, involves a number of new design features including a welded roof truss especially designed by the General Electric Company for such applications. The new building will probably be completed and occupied by summer.

The structure is approximately 140 feet wide, 600 feet long and 50 feet high, and is located at 68th Street and Elmwood Avenue, Philadelphia. Across the Elmwood Avenue end and connecting to an adjoining building is a high-bay or transept spanned by seven of the new welded roof trusses, each having a span of about 72 feet. The main wing of the building has a crane-bay over which are located 20 of the new trusses, each having a span of about 58 feet. There is also a gallery in an adjacent wing over which there are 20 welded trusses each of about 80 feet span.

This method of construction was used because the General Electric Company feels that it permits the use of less metal at less expense to withstand a given stress. Were the building



All-Welded Factory Building at New Plant of General Electric Company.

riveted instead of welded, larger metallic sections would have to be used, as rivet holes are responsible for a certain loss. This loss, according to William Dalton, executive engineer of general plant construction for the company, is equivalent to a strip of metal the full length and thickness of the part in which the hole is punched and as wide as the diameter of the rivet.

In riveted structures, gusset plates are required to connect the various members together at their intersections while, in welded construction, members are directly connected to each other. General Electric experience has shown that these two items alone result in a saving of from 12 to 15 per cent in the amount of steel required when trusses are welded instead of riveted.

Inasmuch as there is a large percentage of metal saved, and as it has been found to cost no more to weld a structure than to rivet it, it is obvious that such a welded structure will cost less than one of the riveted type.

The large trusses used to support the roof on the new building are of particular interest because they involve new ideas in truss design. Each truss consists of two parallel lengths of metal latticed together by a system of tension and compression members, rivets heretofore being used to fasten the units together. The common practice was to construct the trusses with angle iron but, in the new truss, the two parallel members or cords are made of H beams, the tension members are of channel iron and the compression members, H beams. All connections are made by electric arc welding.

The General Electric Company, in order to determine the relative holding values of welded joints, has conducted many tests on welded and riveted joints. In one series of tests, welded specimens were made by the General Electric Company and the actual tests were conducted under the directions of Professor T. R. Lawson of the Rensselaer Polytechnic Institute, in the laboratory of that institution. The tests were made on ¼-, 5/16- and 3/8-inch fillet welds, this type of weld being commonly used in fabricating steel structures from standard rolled steel shapes. On each size of fillet there were made tension and compression tests, fillet lengths being ½, 1, 2, 3, 40, 5, and 6 inches.

A summary of the results of this test showed that a ¼-inch fillet will stand a safe allowable load of 2600 pounds per lineal inch, using four as a factor of safety. Corresponding values for 5/16- and 3/8-inch fillets were 2900 and 3200 pounds. A ¾-inch rivet, the standard size, is estimated to stand a shearing load of 4500 pounds. Based on the results of the tests, a 3/8-inch fillet weld will sustain approximately the same load if deposited for a length of 1½ inches.

Sample roof trusses were constructed by the American Bridge Company, steel contractors in charge of the erection of the new building in Philadelphia, and tests were conducted at that company's plant in Trenton, N. J. At that time a live load double that for which the truss was designed was placed on the truss with satisfactory results. In this test, three trusses of 58-foot span each were used. These were set up in the plant yard, parallel to each other the same as in a building and in such a way that, when loaded, the center truss would carry the load. Deflection readings were taken by means of a fine piano wire held at the ends of the truss and kept taut, a scale graduated in tenths of an inch being used with a mirror to show the deflection under load. The normal live load for which the truss was designed was 30 pounds per square foot of total roof surface. As tested, a load was applied equivalent to full dead load plus 60 pounds live load per square foot of total roof surface. At no time was there any indication of weakness in the structure.

The principal elements from which the building framework was constructed were welded in the shops of the American Bridge Company in Trenton, N. J. These were delivered to the building site and the remainder of the work, necessary to fabricate them into the form of the completed structure, was done on the spot with field welding. Four portable welding outfits were available for use at Philadelphia, but it was found that two only were needed for the majority of the time, three being used at times. One operator per set was all that was needed to do the work. Setting the steel in place for welding required the same force of men as would be necessary for any other structural work.

Work was first started January 11, 1928, and the structural framework was completed by March 1st. It is estimated that, were the building erected by the riveting method, it would have required more time.

The majority of the welding was done with 3/8-inch fillet welds, 5/16-inch fillets being used to some extent at various times. Standard welding sets, each including a suitable motor-generator set, delivered direct current to the arcs.

Work has already been started on the walls of the new building. This will be followed by the installation of woodwork, service piping and other items common to a factory building. The work is being carried on by the U. G. I. Contracting Company of Philadelphia, general contractors. Harris & Richards, architects of Philadelphia, designed the structure.

WELDERS URGED TO SPREAD USE OF WELDING FOR PIPE INSTALLATIONS

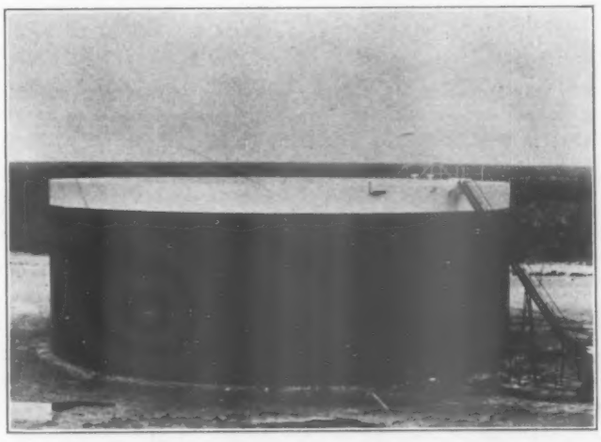
The March issue of "Oxograms," a monthly bulletin issued by The Bettendorf Oxygen Hydrogen Company, Bettendorf, Iowa, contains an editorial by A. J. Russell entitled "The Modern Way," in which welders are urged to take advantage of the

growing acceptance of oxy-acetylene welded instead of fitted pipe lines for all purposes. The company will be glad to furnish literature containing reports of tests and other testimonies that will help convince the prospect of the advantage of welding pipe over the old-fashioned method.

ARC WELDING USED FOR NEW TYPE OF OIL STORAGE TANK ROOF

The Wiggins Breather Roof is a new and novel oil storage tank roof which uses welded construction in a novel way. In the past welding has been used generally on materials of members of a stable or stationary nature. This new roof is designed so that the entire plating (a disc 117 feet in diameter on an 80,000-barrel tank) is held rigid at its edges and flexes up and down in the center to accommodate a breathing action caused by thermal expansion and contraction. The total movement of the middle of the roof ranges from ten inches below center to 12 to 17 inches above center or from 22 to 29 inches.

The roof works on the principle of providing increased vapor space in an oil tank for thermal expansion without permitting a portion of the vapor to escape from the tank and be lost. In the morning and early afternoon as the vapor in the tank above the oil is warmed by the sun, the expansion lifts the roof. Later, in the afternoon and evening as the vapor cools,



Oil Storage Tank With Wiggins Breather Roof.

the roof lowers gradually to its original position on the roof framing.

The manufacturing rights on the Wiggins Breather Roof were obtained from John H. Wiggins, the inventor, by the Chicago Bridge & Iron Works. It was natural for that company, having long experience with arc welded oil storage tank roofs and bottoms to consider welded construction logical for the plating of the new roof.

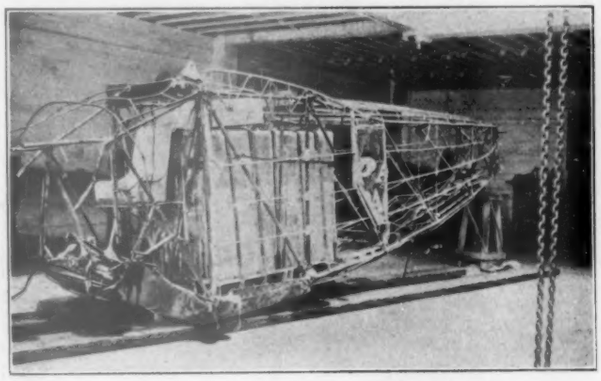
The plating of the Wiggins Breather Roof rests on a roof framing constructed very much like the type used for cone roofs, only that the supports are shorter so as to make the rafters slope down toward the center instead of up. This framing is constructed of channels and the joints are riveted.

The covering or roof proper is constructed of $\frac{3}{16}$-inch plates with single arc welded lap joints. The outside edges of the plates are welded lap joint to the top angle of the tank.

The flexing of the roof sets up a strain in the welded joints of the plates which is not experienced in ordinary tank construction. The actual operation of a large number of these roofs in the field, the first one for 11 months (on 4/7/28) indicate that welded joints will withstand the strains of the breathing action satisfactorily.

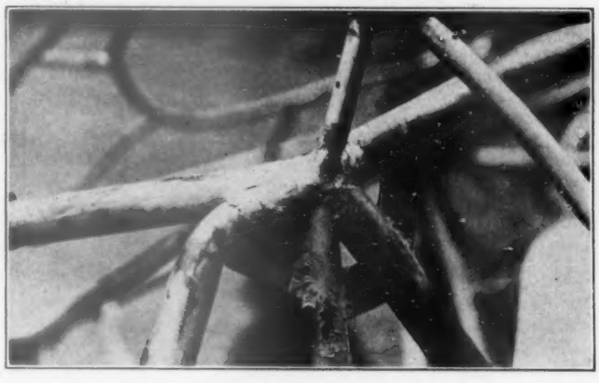
WELDED JOINTS SAVE PILOT'S LIFE

When the plane of Major Irving, one of the entrants in the San Francisco-Hawaii race, crashed immediately after taking off, both pilot and navigator escaped without injury. Much of the credit for this seeming miracle must go to the welded joints



In Spite of Heavy Load and Great Speed, Every Joint Held.

in the fuselage, landing gear, and motor supports, not one of which failed in spite of the weight and speed of the plane. The ring support for the motor, bearing about twenty welds, bore the brunt of the impact, and although bent almost beyond recognition, every joint held.



How a Typical Airplane Joint Holds Up in an Emergency.

The aluminum tanks, which contained 300 gal, of gasoline at the time of the crash, were also welded, and although badly crushed at the corners, did not even spring a leak. The illustrations are reproduced by courtesy of Oxy-Acetylene Tips.

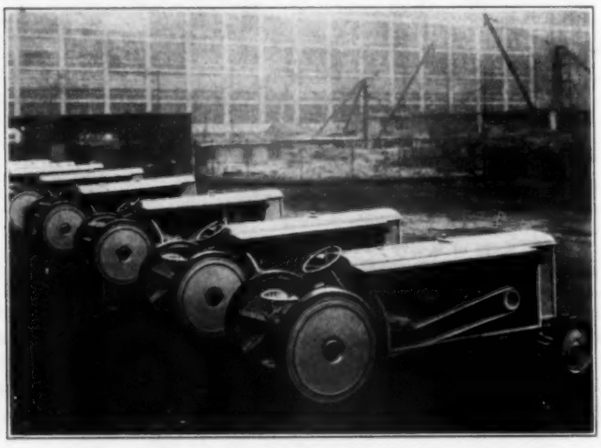
CLEVELAND WELDING SCHOOL PLANS SERIES OF INSPECTION TRIPS

On Wednesday, April 4th, the classes of the Cleveland Welding School visited the plant of the Una Welding & Bonding Co. and were given a demonstration of fish plate welding both by the carbon arc and the metallic arc process; also a demonstration of copper bonding using the carbon arc for same. The demonstration concluded with a chance to see manganese welding applied to a worn rail joint. Mr. Austin of the Una Welding & Bonding Co. officiated. This visitation to the Una plant is only one of a series planned by Mr. Randall of the Cleveland Welding School for his classes. This tour of inspection will include foundries, automobile plants, tank shops, and other shops where salvage welding is carried on in a large scale.

NEW WELDER TRACTOR COMBINATION

An improved combination of electric arc welder and Fordson tractor is now offered by the General Electric Company. The principal improvements consist of the substitution of a new type welding equipment and the addition of head and tail lights and a protective cover. This outfit is now being marketed direct by the General Electric Company; the older outfits utilized General Electric welding equipment but were not sold by that company.

The principal equipment consists of a standard Fordson tractor, belt-connected to a type WD-300-A, 25-volt, 300-ampere one-hour rated 1750-r.p.m., ball-bearing generator.



General Electric Engine-Driven Welding Generator Mounted on Fordson Tractor.

This unit is mounted directly on the tractor and is protected by metal canopy and canvas side curtains. Other equipment includes governor, power take-off, muffler, waterproofed pulleys on engine and generator, belt and belt tightener, industrial (disc type) rubber tired wheels front and rear, extension frame, off-set crank, control panel and reactor, head and tail lights, and battery and charging control. As optional equipment the following are available: light industrial (spoke type) wheels front and rear; standard Fordson farm wheels front and rear, and any other desired accessories.

The overall length of the complete unit is 12 feet; the height is four feet eight inches; the width is five feet two inches, and the net weight is approximately 4900 pounds.

Among other applications, this equipment is particularly useful to welding contractors, boiler shops, marine repair shops, structural field contractors, oil well drilling companies, oil refineries, pipe line owners and tank builders. The outfit has been particularly designed to provide such activities with a complete, portable welding machine suitable for hard, continuous use. The utility of the tractor as a hauling device has not been impaired. For field use, the unit will haul equipment and tools to the job and then supply welding current for the work. For welding pipe lines and for use along railroad rights of way, extra long welding leads are not necessary because the equipment is so easily moved at a moment's notice.

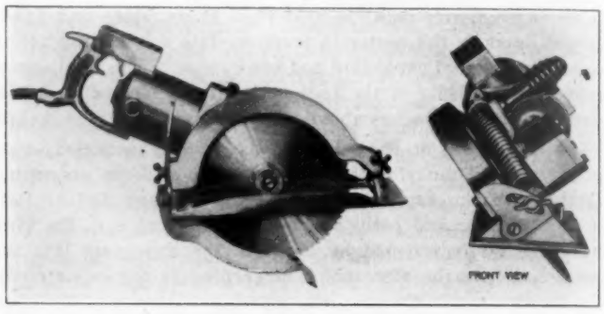
The battery, which supplies current for the lights and ignition is charged while the welding generator is operating. It is provided with ammeter and automatic cutout.

BRITISH OXYGEN COMPANY ISSUES BOOKLETS ON CUTTING MACHINE

The Universal Oxygen Cutting Machine, product of the British Oxygen Company, London, is interestingly described and illustrated in a 16-page booklet which shows the machine in operation in a number of shops representing various industries where it is now in use. This book was specially prepared for the recent British Industries Fair at Birmingham. Another booklet gives a detailed description of the machine and its mechanism, and also furnishes useful information concerning steel cutting, with further illustrations of the applications of the machine. These booklets may be obtained by writing the Company at Angel Road, Upper Edmonton, London, N. 18.

WODACK PRODUCES NEW PORTABLE ELECTRIC SAW

A portable electric hand saw, known as Type B, operating on 110-volt, 220-volt, or 250-volt D.C. or A.C. current, has been developed by the Wodack Electric Tool Corporation, 4627 W. Huron St., Chicago. This saw is designed not only for vertical



Wodack Type-B Portable Electric Hand Saw.

sawing but also for bevel sawing at any angle up to 60 degrees. Another new feature is that of the width gauge for vertical sawing, which can be set for any width up to 6 inches. By this means, various widths of strips can be cut with accuracy without the necessity of marking.

NEW CARBIC SALES AGENTS

The widely used Carbic acetylene floodlight which has aided thousands of contractors, road builders and others to operate night shifts economically, and the Carbic acetylene generator, as well as other Carbic equipment utilizing acetylene, formerly sold by the Carbic Manufacturing Company, Duluth, Minn., will in the future be distributed exclusively by the Oxweld Acetylene Company, 30 East 42nd Street, New York.

The processed carbide in cake form, sold under the trademark Carbic, for Carbic lights and generators, will be distributed exclusively by the Union Carbide Sales Company, New York, through its nationwide chain of warehouses.

With the distribution and service facilities of these two above mentioned selling agents, users of Carbic products will not only be assured of the satisfactory service which they have heretofore received, but will also benefit materially by the more extensive facilities through which distribution of the products will in the future be made.

WAXED PAPER FOR RECORDING INSTRUMENTS

In 1912 there was attempted the manufacture of a wax sensitized paper which would record automatically on all graphic recording devices without the use of ink. This product was manufactured on a very limited scale for a number of years, during which time a few manufacturers of recording instruments adopted it while the majority of production was sold for office copy purposes.

The concern manufacturing this product went out of business a number of years ago at which time those concerns who had adopted the article bought up all of the remaining stock on hand.

In 1924 these stocks had been exhausted and the manufacturers in need of the article went to the Mayer Coating Machines Company for the production of the article, after having tried to secure

its production through numerous other regular manufacturers of coated papers. None of these other concerns were successful but the Mayer Coating Machines Company succeeded in developing the necessary formula and process for turning out a perfected article which went into general sale about two years ago.

A new company was formed and is known as The Stylograph Company, at Rochester, New York, which now manufactures and distributes this article.

These wax sensitized charts are now used on about one dozen different types of recording instruments with very wide usage and now that the article is available for general purchase, it is expected that a large number of these manufacturers of recording graphic devices will adopt Stylograph charts.

WILSON PUBLISHES BOOKLET ON WELDING ESSENTIALS

A twelve-page bulletin entitled "Good Welding Essentials" has been prepared by Alexander Churchward, Technical Director of The Wilson Welder and Metals Co., Hoboken, N. J. The purpose of the booklet is given in the introduction, as follows:

"We have taken for granted that individuals or companies that have owned and operated arc-welding machines for a year or more know the essentials of good welding, but to our surprise we have found that in many instances the knowledge of welding in certain companies is allowed to remain solely with the operator of the machine, who like as not became an arc welder when his employer purchased the outfit and developed his skill by constant practice, and cut and try rather than weld and break methods. For these companies and their welder operators we have decided to write a paragraph or two on good welding essentials."

There follow chapters on behavior of the arc, advantages of the short arc, disadvantages of the long arc, how to determine the proper current for any particular job, how to determine a good weld, preparation of the work, causes of bad welds, influence of length of arc on strength of weld, and general information regarding carbon and metallic electrodes.

LINCOLN ISSUES NEW CATALOG OF MOTORS

The Lincoln Electric Company, Cleveland, Ohio, has prepared a 26-page catalog illustrating their complete line of "Linc-Weld" motors, the frames of which are made of steel and fabricated by welding. Some of the advantages claimed for this type of construction are greater strength and durability, simplicity, ease of making repairs, greater ventilating space and better rotor connections. The Lincoln Automatic Induction Controller and the "Stable-Arc" Welder are also illustrated in this catalog.

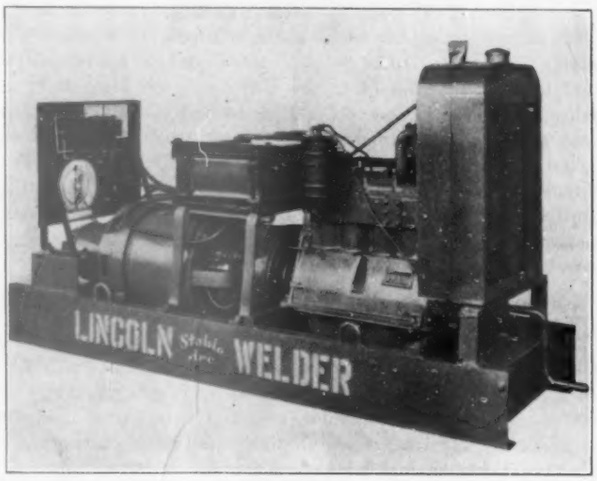
NEW GAS ENGINE DRIVEN WELDER

To meet the growing demand in construction work of all kinds for a self contained, light weight, readily portable arc welder with its own motive power, The Lincoln Electric Company of Cleveland, Ohio, announce a new model of the "Stable-Arc" welder, known as their S-1960 Model.

The new unit has a rating of 200 amperes according to N.E.M.A. standards, with a current range for welding duty of from 50 to 300 amperes, and operates at a speed of 1500 RPM. Motive power is provided by a four cylinder Continental Red Seal Engine, type H-9.

The welding generator and engine are mounted on a structural base welded into a solid piece of steel. This welded steel base provides a maximum stiffness and rigidity with a minimum weight; the whole unit weighing only 1580 lbs. and being only 76 inches long by 25 inches wide. The generator is also constructed of steel, thus not only reducing weight but also reducing the possibility of breakage in the field.

The complete magnetic circuit of the generator is of laminated steel structure, thus increasing the stability of the arc which is highly desirable in work for which this unit was brought out, because many times welding must be done in a vertical plane and frequently overhead. A steel switchboard



Lincoln Model S-1960 Engine-Driven Welder.

is also provided, still further reducing the possibility of damage in the field.

It is stated by the Company that this unit is not designed to replace their present heavy duty engine driven equipment but to meet the need for a light but sturdy unit.

GIBERSON COMPANY MOVES MAY 1ST

E. D. Giberson & Co., Inc., 40 Rector Street, New York City, manufacturers of "Excelo" welding rods and "Gibco" boiler tubes and pipe, will open on May 1st their New York warehouse at West 37th Street and 11th Avenue, where will be maintained a very large stock of all grades of welding wire; boiler tubes, seamless steel mechanical tubing, etc. In addition to the "Excelo" line of gas and welding rods previously marketed, Giberson & Co. are now offering flux-coated "Excelo" welding rods in all grades. Stocks are maintained at Pittsburgh, Pa., in addition to New York. This company is also Eastern representative for the Lebanon Iron Company, Lebanon, Pa., manufacturers of iron bars, bolts and nuts, spikes, rivets, etc.

UNDERWRITERS' STANDARDS FOR BLOWPIPES AND REGULATORS

The Underwriters' Laboratories, Chicago, Illinois, have issued bulletins dated March, 1928, on standards for (1) Blowpipes or Torches for Welding, Cutting, Heating, Leadburning and Soldering and (2) Pressure Regulators or Reducing Valves. These standards were originally issued November 30, 1926. There have been no changes in any of the specifications. On and after April 1, 1928, these standards will be regarded as in effect. The object in publishing these bulletins is to establish the specifications as standard that have been found acceptable to the majority of the industry.

TABULATION OF PROPERTIES OF SPECIAL ALLOYS

There has been received from Chemical and Metallurgical Engineering, Tenth Avenue at Thirty-sixth Street, New York City, a four-page folder printed on heavy durable paper containing tables of the properties of alloys for resistance to corrosion and heat and electricity. These tables give a considerable quantity of very useful and interesting information on

most of the well known brands of stainless steels and other special alloys, including their chemical composition, physical properties and their resistance to water, acids, heat, etc.

PURDUE WILL HOLD CONFERENCE ON STEEL TREATING

The Engineering Extension Department of Purdue University, Lafayette, Indiana, has announced a conference on steel treating to be held at the University on May 10th and 11th under the direction of the Engineering Extension Department and the Department of Practical Mechanics, with the School of Chemical Engineering and the Indianapolis and Fort Wayne Sections of the American Society for Steel Treating cooperating. This two-day program will be devoted to the fundamental problems of steel treating and should interest all manufacturers of metal products.

NEW ALUMINUM SOLDER

The Miller Aluminum Solder Company of Louisville, Kentucky, has recently announced the Miller aluminum solder which they claim is giving unusually satisfactory results on both sheet and cast aluminum. Special mention is made of the efficiency of this solder on light aluminum castings and also that it can be molded to any form.

BOOK REVIEW

THE WELDING ENCYCLOPEDIA SIXTH EDITION

The latest edition of this book maintains the arrangement of the subject matter on the different welding processes which has been followed in previous editions. The first section of the book arranges alphabetically the words, terms and trade names commonly found in welding literature, with treatises on the more important and less understood subjects. This is followed by four chapters dealing separately with oxy-acetylene welding, resistance welding, electric arc welding and thermit welding. Separate chapters are then devoted to special types of welding applications, such as boiler welding, pipe welding, tank welding, etc. A chapter on training operators gives outlines of lectures and practice exercises for students in both oxy-acetylene and electric arc welding and includes sets of examination questions. A special section is devoted to various kinds of rules for the installation and operation of welding equipment, concluding with a collection of charts and tables of interest to welders. The catalog section lists the products of the principal manufacturers of welding equipment and supplies in the United States. In the new edition there have been numerous additions to the text which give concise and practical summaries of the new developments in the application of the different welding processes during the past two years. The book is well bound in black imitation leather; contains 496 pages and over 600 illustrations. The price is $5.00 per copy. It is published by The Welding Engineer Publishing Company, 608 South Dearborn Street, Chicago, Illinois.

NEWS OF THE WELDING TRADE

The American Chain Company, Inc., Bridgeport, Conn., has purchased the business and trade name of the Wright Manufacturing Co., Lisbon, Ohio, manufacturers of chain hoists, trolleys and cranes. Mr. H. F. Wright and Mr. W. F. Wright will continue in their respective positions in production and sales of Wright products.

Steel and Tubes, Inc., Cleveland Ohio, has announced that it will soon begin the manufacture of electrically welded metal tubing at its Brooklyn, N. Y. plant. This is a thin walled conduit tubing, in diameters from ⅜ in. to 1 in.

Mr. F. B. Toombs, General Sales Manager of the Chicago Steel & Wire Co., is on a four weks' trip to the Pacific Coast states.

It is reported that the Cuyahoga Boiler Works has been purchased by the Boom Boiler and Welding Company, Cleveland, Ohio, which is expected to operate the former outfit in connection with its own plant.

The Westinghouse Electric and Mfg. Co. has appointed J. G. Sneby welding engineer of the South Philadelphia works of the company. Mr. Sneby is a graduate mechanical engineer and has been connected with the plant at South Philadelphia for the past six years.

S. Fix and Son, Cleveland, Ohio, specializing in boiler tube welding, has changed its name to S. Fix's Sons and moved to a new plant at 1826 Col. Road, Cleveland.

Report has been received that the Union Carbide and Carbon Corp., New York City., is making plans for a one-story plant in Hollywood Section, Memphis, Tenn., and is also planning a new plant for its subsidiary the Prest-O-Lite Co. at the same location. The Memphis Oxygen Co. plant has recently been purchased by the Linde Air Products Co., also a subsidiary of the Union Carbide and Carbon Corp. The completion of all these plants will give the Union Carbide and Carbon Corp. facilities for complete oxy-acetylene service in the Memphis district.

Bronze Welding is the subject of a paper to be read by W. Steele before the meeting of the Institution of Welding Engineers, London, at Caxton Hall, Friday evening, March 30th.

G. O. Carter, Welding Engineer for the Linde Air Products Company, New York City, will read a paper on "Economies in Oxy-Acetylene Cutting for Riser Removal" before the meeting of the American Foundry Men's Association, which will be held at Philadelphia, May 15th.

Henry Booth, General Sales Manager of the Shawinigan Products Company, New York City, has returned from a Winter vacation spent in and about Trinidad, B. W. I., which he reports to have a delightful climate in Winter time.

Announcement has been received that the Leslie Welding Co. has finished work on its new plant, which is located at 2943 Carroll Avenue, Chicago. The new plant manufactures wrought iron furniture and iron novelties and also does spot welding and butt welding on contract.

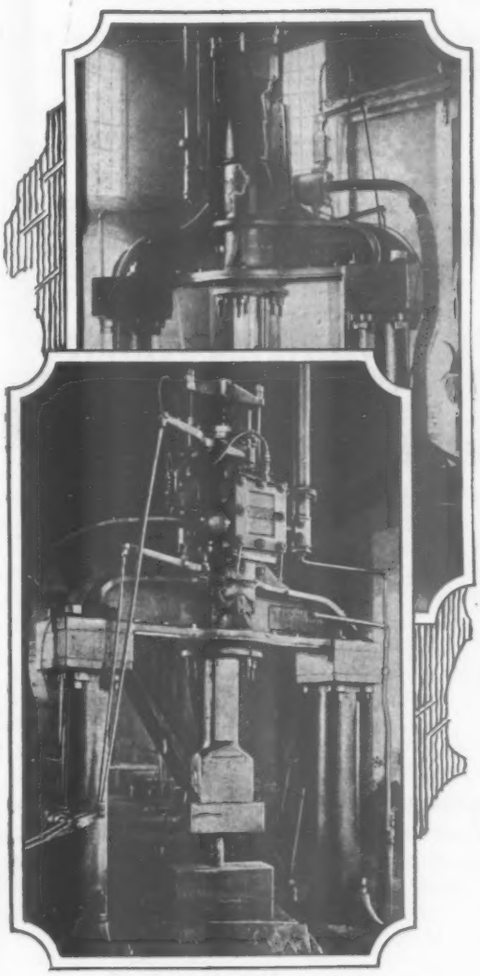
The speaker at the March meeting of the Boston Section of the American Welding Society was M. A. Thompson, Welding Superintendent of the Boston and Maine R. R. His talk covered both welding and cutting.

The Lincoln Electric Company, of Cleveland, announces the appointment of Jacob Savela as welding service manager for the Detroit district, under the direction of Mr. J. M. Robinson, district sales manager. Mr. Savela is a graduate of the University of Michigan and has had a wide practical experience in electric arc welding.

The Peoples Gas and Power Co., Chariton, Iowa, is installing a new 30-foot gas scrubber of the dry bottom type and a moisture separator. It will be built of welded construction by the Semet-Solvay Engineering Corporation, of New York. The new equipment also includes a quantity of Steere welded steel pipe and gate valves connecting relief holder, scrubbers, purifiers and meter.

At the March meeting of the Cleveland Section of the American Welding Society the speaker was Prof. H. M. Boylston who presented an illustrated talk on the subject of "Metallography and Its Application in the Welding Industries."

Giant Steam Hammer
in Railway Shop
Welded with Tobin Bronze



Front and back views of repaired steam hammer.

THIS steam hammer, in the Algiers, La., blacksmith shop of the Southern Pacific Lines, operates a weight of 1100 pounds. In February, 1927, the cylinder cracked as indicated by the white lines in the photographs.

The breaks were all repaired with Tobin Bronze welding by the oxy-acetylene process, and the hammer has been in operation ever since, as sound and strong as ever.

It would probably have caused a delay of thirty days to construct a pattern, and make and finish a new casting. With Tobin Bronze Welding twelve hours of a machinist's time and sixteen of a welder's were required. Fifty pounds of Tobin Bronze Welding Rods, 400 feet of acetylene and 600 feet of oxygen were used.

This is a typical example of how Tobin Bronze welding saves time and cuts down costs, both in repair work and in manufacturing operations.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

TOBIN BRONZE
REGISTERED U. S. PATENT OFFICE
WELDING RODS

EXCLUSIVELY AN ANACONDA PRODUCT

An Outstanding Achievement

The All-Welded Steel Barge

Kjekstad Trussweld System

(Patents pending)

Now completing Diesel engine-propelled steel tank barge, 102x20x8, 65,000 gallons, with 6 ft. 6 in. draft. Approved and classed ✠A1® by American Bureau of Shipping. Vessels constructed under the Kjekstad Trussweld System possess greater strength with less weight, cost less to build and maintain, and are constructed more rapidly. It is adaptable to all types.

When requiring

WELDED PIPE, TANK, FLOATING EQUIPMENT AND OTHER STEEL CONSTRUCTION, we will be pleased to submit plans.

WELDING SOS CORPORATION

S O S WELDING CORPORATION

502 Hamilton Ave., Brooklyn, N. Y.

Telephones Huguenot 1610-1611

INDUSTRIAL GASES

I.O.C. SYSTEM

OXYGEN HYDROGEN
ACETYLENE NITROGEN
PRIMOGAS

GENERATING APPARATUS

Cylinders—Valves—Regulators
Eyeosee and International Welding and Cutting Torches
Welding Wire—Fluxes
Cast-Iron and Aluminum Rods
Plain and Armored Rubber Hose
Asbestos Pads and Paper Goggles, etc.

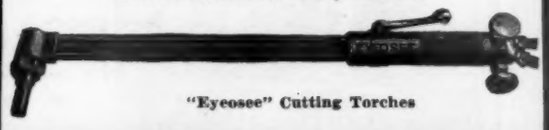
All Equipment Fully Guaranteed.
Quick Shipment and Low Prices.

KNOWLES ELECTROLYTIC PLANTS

for the production of hydrogen

Knowles Patented Cells are safe, simple, easy to install, automatic, low in first cost and maintenance, and in addition to flexibility of operation have the advantage of producing also a quantity of pure oxygen equal to 50 per cent of the hydrogen volume. All sizes up to 15,000 amperes. Total annual hydrogen capacity of plants now in operation, over one and one-half billion cubic feet. Our experience as American Manufacturers and Distributors enables us to recommend these plants unqualifiedly.

Write for literature and quotations



"Eyeosee" Cutting Torches

INTERNATIONAL OXYGEN COMPANY

Main Offices: Newark, N. J.

Branches: New York Pittsburgh Toledo Buffalo

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

One Dollar will increase your earning power by bringing you one of the following GUARANTEED FLUX FORMULAS—cast iron, brazing, copper, nickel, high speed steel, aluminum (sheet and cast). With instructions you can make up your own fluxes fresh. R. N. Robbins, 38 Winans Street, East Orange, N. J.

Salesmen Wanted—Whole or part time, to sell "Gold Seal" bronze welding and brazing fluxes to the welding trade. Just out. Apply promptly for territory. Good side line. Gold Seal Mfg. Co., Cor. of Como and Pascol Aves., St. Paul, Minn.

Wanted—Expert welding engineer, by large corporation doing national business in wire electrodes. Must have knowledge of sales work as well as practical welding. State age, whether married, experience, education, and salary expected. Address Box No. 153, care The Welding Engineer.

Wanted—Experienced salesman to act as representative for mill manufacturing welding wire exclusively. Address Box 154, care of The Welding Engineer.

Wanted—Used Lincoln Arc Welders. Give history and full details in your reply. Address Box No. 152, care The Welding Engineer.

Position Wanted—Electric and gas welder and gas plant operator, with 14 years' experience. Now in charge of gas plant. Familiar with installation and operation of all kinds of arc welders, gas compressors, etc. Competent welding foreman, well versed in shop methods. Will accept position in any part of the world. References. Louis Sudhop, 1541 Makiki St., Honolulu, Hawaii.

Positions Wanted—In the United States. Two gas welders, thoroughly experienced in wide variety of work, designed for pressures of 2,000 to 8,000 lbs. Can handle any job in pipe, steel tube, or boiler welding; also any type of joint with plate or structural shapes. Address George H. Jones, 10 Acacia Ave., Newport, Man., England.

REBUILT WELDERS

We specialize in guaranteed rebuilt

ARC WELDERS
SPOT WELDERS

Goodman Electric Machinery Co.
Newark New Jersey

"STANDARD"

Welding Wire

GAS AND ELECTRIC

A grade for each type of work—send for samples.

for sound permanent welds : : lower costs

Our costs are considerably under those of large industrial centers; ours is a one-profit wire sold direct to user from our own mills exclusively devoted to making of welding wire from raw material to finished product—hence our extremely low prices for wire that is definitely superior. Adopted exclusively by many large users.

Prices on request.

Standard Steel & Wire Co., Greensburg, Pa. (Mills at Bolivar, Pa.)

An Economical Welding Rod

Price is not the only factor that determines economy. Uniformity and dependability play a larger part in the cost of making good welds than the price per pound of welding wire.

"Seneca Gas Weld"
"Seneca Electro Weld"

are uniform and dependable because they are made by our own processes from specially selected stock. They are produced as Special Soft, Medium, Hard, Extra Hard, shipped in coils or straight lengths, in Black, Bright, Coppered Finish, Flux Coated.

Your inquiries will receive prompt attention

The Seneca Wire Mfg. Co.
Established 1905
Fostoria Ohio

AGENTS WANTED—COMMISSION BASIS

For welds that must be both STRONG and DUCTILE

Genuine Swedish Iron

possesses the physical properties absolutely demanded of a welding wire which must meet this requirement. Its excellent working qualities are the result of using an iron that is practically free from all impurities,—genuine Swedish Iron.

If you haven't tried Genuine Swedish Iron, send us a trial order.

Attractive proposition for distributors.
Write for details

THE BISSETT STEEL COMPANY
CLEVELAND OHIO

BRANCHES

CHICAGO 330 S. Wells St. | CINCINNATI | DETROIT 7338 Woodward Ave.

Southern Agent
F. A. Tayler, Richmond Trust Bldg., Richmond, Va.

Cutting Acetylene Costs For Both Producers and Users

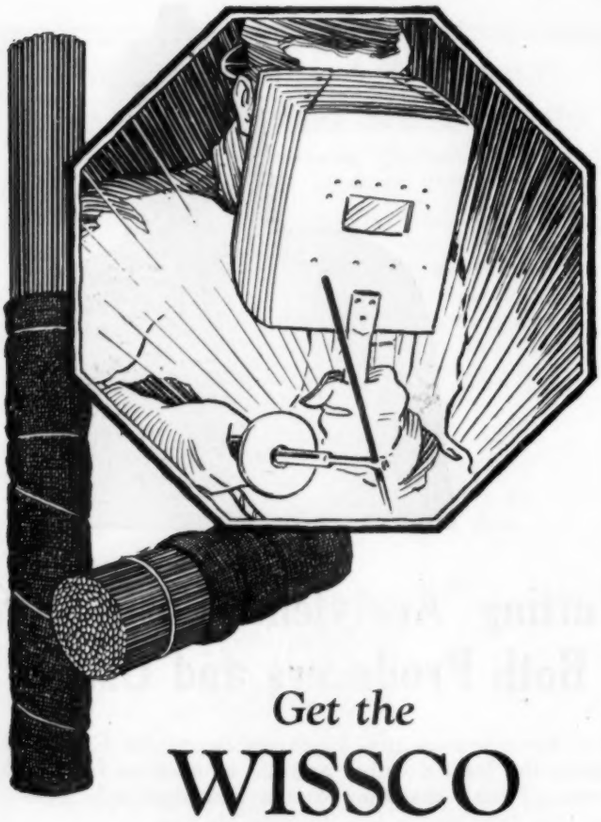
Tests have proven that Hackney Acetylene Cylinders require the least possible amount of acetone for a full charge of gas—that their discharging time is longer—and that they retain less inaccessible gas.

This can mean but one thing—lower costs for both producer and user. Because they require less acetone, Hackneys cut charging costs for the producer. Longer discharging time and a minimum of inaccessible gas means more value per cylinder for the user.

Directly responsible for this is Hackney's filler. Many Hackney Cylinders have been in service for years and have to their credit filling records that mount up into the hundreds. Still their cores show no signs of deterioration, indicating that Hackney Cylinders are built to last. $99\frac{7}{10}\%$ of all those manufactured in the last 17 years are in active service today. Such a record speaks for itself.

Send for more complete information

PRESSED STEEL TANK COMPANY
MILWAUKEE, WISCONSIN
1155 Continental Bank Bldg., Chicago
1331 Vanderbilt Concourse Bldg., New York
5731 Greenfield Ave., Milwaukee



Get the
WISSCO
angle on your
Welding Rod
problems

Good welding equipment requires the highest quality welding rods obtainable.

Wissco Welding Rods are pre-tested—and successfully meet and pass all exacting requirements for Electric and Gas Welding.

Then again. Wickwire Spencer offers you the cooperation of its Engineering Department to help select the welding stock best adapted to your particular needs.

If you are interested in more economical and better welding put your problems into the hands of the Wissco Engineering and Metallurgical Department.

Make your problems theirs!

GET IN TOUCH WITH THEM NOW, TODAY!

Wickwire Spencer Steel Company
41 East 42nd St.
New York City

WICKWIRE SPENCER STEEL CO.

WICKWIRE SPENCER PRODUCTS

Big Jim (Master Welder)

says:

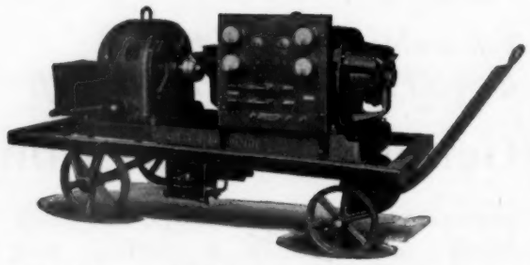
I used to think I could make just as good a weld whether my welding bar was square, round or flat. But I know different now. It's square bars for me from now on—square FRE-FLO bars. They sure know how to make 'em. Not a trace of bur or fin—no place for grains of sand to stick. And that means a *clean weld* every time.

[Want a sample of FRE-FLO? Just drop us a post-card.]

Big Jim (MASTER WELDER)

FRE-FLO rods are sold only through distributors. A few desirable territories are still open. Correspondence from distributors is invited.

The Atlas Foundry Company
Department "B"
W. 69th & W. & L. E. Ry. Cleveland, O.



More Welds at lower cost

Burke Variable Voltage Welder

In addition to the single operator type of welder we build a two-operator machine which is distinctively a Burke development.

Either operator can regulate for his own requirements without affecting the other and may use any proportion of the capacity of the welder as long as their total demands are not greater than the rated output of the machine.

The results are self evident—greater production, flexibility and lower cost per weld.

Bulletin No. 133 gives complete description and superior features. *Write for it.*

BURKE ELECTRIC COMPANY
ERIE, PA.

Service Sales Offices:
NEW YORK CHICAGO PHILADELPHIA PITTSBURGH
CLEVELAND DETROIT BUFFALO

Sales Agencies:

AKRON	KANSAS CITY	CINCINNATI
Berthold Elec. & Eng. Co.	W. T. Osborn	Underwood Elec. Co.
INDIANAPOLIS	TROY, N. Y.	MINNEAPOLIS
W. C. Fletcher Co.	E. I. Van Doren	H. C. Lemire

When buying CARBIDE — Ask for NATIONAL

BEST for All Industrial Purposes

—

IN THE RED DRUM SAVES YOU MONEY

—

Warehouses in All the Principal Cities

National Carbide Sales Corporation, 342 Madison Ave., N. Y.

There's More Welding in the K-G Torch

K-G Torches have a high rating for real value because they have such long welding life. Because of the simplicity of design and careful selection of materials they are practically everlasting, and perfect proportioning of the gases makes them free from injurious flashbacks. You don't know what good strong torch construction can do to keep down your welding costs until you have given the K-G a thorough trial.

K-G WELDING & CUTTING CO.
INC.
515 West 29th St.
Phone Chickering 0996-7-8
New York City

A Standard K-G Welding Unit—Every Part Dependable

Three requirements of K-G Apparatus are: It must eliminate waste of gas and time; it must be made for hard service; and it must be perfectly safe under all operating conditions.

Scientific Simplicity Gives More Value at No Greater Cost

K-G

Uniform Quality Assured

WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

Your torch can tell the difference!

COMMERCIAL ACETYLENE
Means pure acetylene.

COMMERCIAL SERVICE
Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

10x30-in. size	125 cu. ft. cap.
12x36-in. size	225 cu. ft. cap.
12x44-in. size	275 cu. ft. cap.

Commercial Acetylene Supply Company, Inc.

General Office: 71 Broadway
New York City

BRANCHES:

600 W. Jackson Blvd. Chicago, Ill.
708 Thrower Bldg. Atlanta, Ga.
683 Atlantic Ave. Boston, Mass.
417 Market Street San Francisco, Calif.

How?

PROCESSED

takes the guess out of welding wire

Every type of welding work has certain individual requirements. All Page Welding Wire and Electrodes are processed by special Page methods to meet the exact requirements of the type of work for which they are recommended.

Each piece is plainly stamped with an identification mark and an actual shop test made to prove its performance "on the job."

The result is welder's time saved, better work and lower costs. Prove this for yourself with a sample. Your name and address bring it.

PAGE STEEL AND WIRE COMPANY

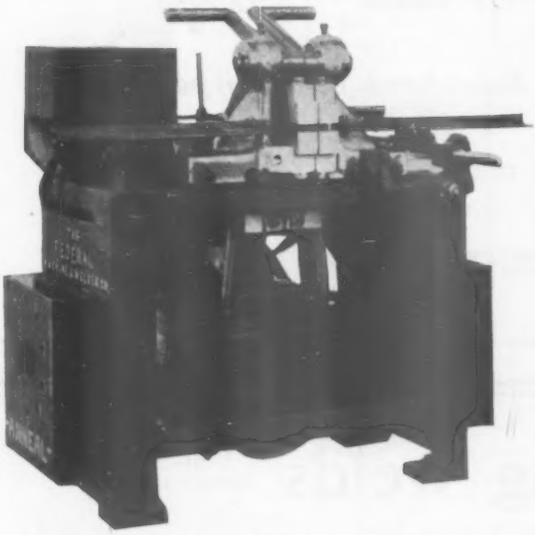
Bridgeport, Connecticut

District Offices: Chicago, New York, Pittsburgh, San Francisco
An Associate Company of the American Chain Company, Incorporated, Bridgeport, Conn.

PAGE-ARMCO PROCESSED Welding Wire *and* Electrodes

It Welds—
then
It Anneals

This combination band saw welder and annealer, a recent Federal development, will be in great demand by both manufacturers and large users of band saws.



2-S Band Saw Welder and Annealer

Capacity up to and including 1½ inch width saw.

The nearest approach to ideal service is obtained from band saws which are electrically welded and then annealed. This new Federal machine takes care of both operations. All that is necessary after welding is to reclamp the saw, apply the annealing current for a few seconds, and the saw is both welded and properly annealed. We will gladly supply further particulars of this new Federal welder upon request.

Federal makes a complete line of spot, butt and seam welders of both standard and special designs. Federal engineers are ready at all times to assist you with your welding problems.

You may depend upon them to make intelligent recommendations on the use of electric resistance welding in your production program.

FEDERAL MACHINE & WELDER CO.
Dana Avenue Warren, O., U. S. A.
Branch Offices in All Principal Cities

NOW! Lower Welding Costs

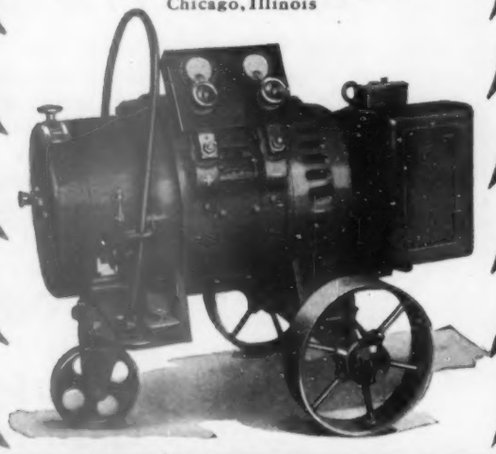
Analysis of welding cost shows that labor is two-thirds of the total expense—consequently a welding machine easier to work with will result in turning out more and better work, and decreasing the labor cost per unit.

With the Fuzon Welder, the arc can be maintained easily—the machine gives a truly "flexible" arc. Changes in arc length are instantly compensated for without extinguishing the arc. Therefore, there is less fatigue on the operator and he can turn out more work.

Furthermore, there are no exciters, external stabilizers, rheostats, etc., to overheat or get out of order. Rugged construction, simple design, operating efficiency, a wide current range with one simple control, makes the Fuzon Line of Arc Welders the most logical.

Investigate Fuzon Arc Welders—a type and size to meet every requirement. Write for Bulletin W4.

FUSION WELDING CORPORATION
Welding Equipment and Supply Division of
CHICAGO STEEL & WIRE COMPANY
103rd St. and Torrence Ave.
Chicago, Illinois



FUZON ARC WELDERS WELDITE WELDING ROD

You Can Do It Better With TORCHWELD

Aeroplane manufacturers selected Torchweld welding torches for two reasons:

First: because the lives of human beings were dependent on the strength and quality of these welds.

Second: to keep their production welding departments operating at the highest efficiency.

Torchweld torches produce welds strong enough to satisfy the flyer and dependable welds for the designer.

This is only one of the many production welding operations accomplished by Torchweld Non-Flash Welding Torches.

for

Security

use

The Standard of Comparison

GET THE FACTS. Write for Catalog No. 28

TORCHWELD EQUIPMENT COMPANY
224 N. Carpenter St. CHICAGO

---*for* Strong welds

Nichrome

TRADE MARK REG. U. S. PAT. OFF

---*the exceptionally strong* Welding Rod

Welds made with "Nichrome" the nickel-chromium alloy, possess exceptional strength. For example, practical tests of welds on mild steel made with "Nichrome" rods, show an ultimate tensile strength as high as 55,000 pounds per square inch. It is interesting to note that the welding operation does not detract from the metal itself.

"Nichrome" welds are readily machinable and may be applied by either the oxy-acetylene or arc welding process. The ease of application and free flowing qualities of "Nichrome" welding rod, together with the fact that it can find wide application, makes its use extremely desirable.

Sample? If you are having difficulty in getting a strong weld, we are sure "Nichrome" will prove satisfactory. *Sample rods will be sent on request.*

DRIVER-HARRIS COMPANY
HARRISON, NEW JERSEY
Chicago - Detroit - Morristown, N.J. - England - France

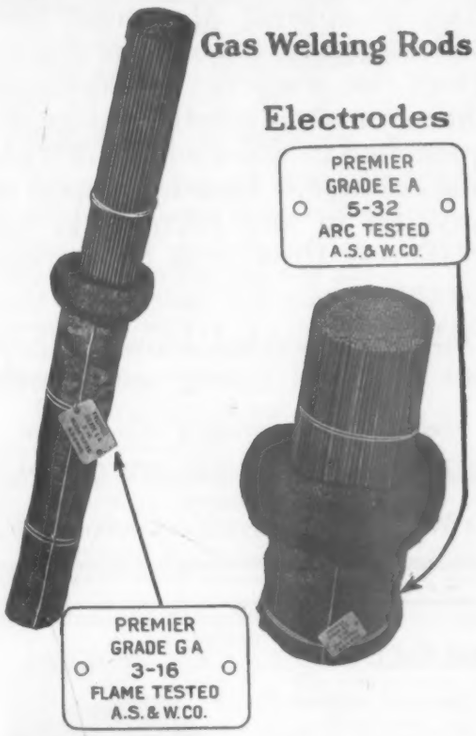
Alloy Makers since 1899

American Steel & Wire Company's

PREMIER

TESTED

WELDING WIRES



PREMIER Welding Wire flows freely, giving perfect fusion, thorough penetration and the desired finish. The uniform quality of Premier Welding Wire insures a deposit of metal in the weld free from foreign inclusions and possessing maximum strength. Before shipment, every bundle is electrically tested and manually welded. Permanently satisfactory welds and a saving of gas, electricity and the welder's time are thereby assured.

For a dependable welding job, use an appropriate grade of Premier Welding Wire. Send for booklet giving full information and specifications.

American Steel & Wire Co.

SALES OFFICES

CHICAGO.....208 So. La Salle St.	NEW YORK.....30 Church St.
CLEVELAND.....Rockefeller Bldg.	ATLANTA.....101 Marietta St.
DETROIT.....Foot of First St.	WORCESTER.....94 Grove St.
CINCINNATI.....Union Trust Bldg.	BALTIMORE.....32 So. Charles St.
MINNEAPOLIS—ST. PAUL.....	BUFFALO.....670 Ellicott St.
....Merchants Nat'l Bank Bldg., St. Paul	WILKES-BARRE.....Miners Bank Bldg.
ST. LOUIS.....506 Olive St.	DALLAS.....Praetorian Bldg.
KANSAS CITY.....417 Grand Ave.	DENVER.....First Nat'l Bank Bldg.
OKLAHOMA CITY.First Nat'l Bank Bldg.	SALT LAKE CITY....Walker Bank Bldg.
BIRMINGHAM.....Brown-Marx Bldg.	*SAN FRANCISCO.....Russ Bldg.
MEMPHIS.Union and Planters Bank Bldg.	*LOS ANGELES....2087 E. Slauson Ave.
BOSTON.....Statler Bldg.	*PORTLAND.....6th & Alder Sts.
PITTSBURGH.....Frick Bldg.	*SEATTLE.....4th Ave. So. & Conn. St.
PHILADELPHIA.....Widener Bldg.	*United States Steel Products Company

Imperial

OXY-ACETYLENE

Welding and Cutting Equipment

There was a time when a few broken teeth meant the scrapping of the entire gear—but that was before Imperial Welding was known. Now there is no metal or machinery part that cannot be quickly and permanently repaired by means of the Oxy-Acetylene Welding flame.

There are hundreds of uses for Imperial Welding and Cutting Equipment in every plant where metal or machinery is used. Blowholes discovered after or during machining can be quickly filled. Holes punched or drilled incorrectly may be filled and, when dressed off or machined, no sign of the weld will show. Shafts or rods, made too short, may be extended. And hundreds of other accidents of frequent occurrence may be economically corrected with Imperial Equipment.

Imperial Oxy-Acetylene Welding is daily finding new uses in production operations where it increases output and cuts costs. Let our engineers suggest the correct type of equipment for you.

Send for New Complete Catalog

The Imperial Brass Mfg. Co.

517 South Racine Ave., Chicago

Don't Use Costly Gas and Time Getting a Neutral Flame

The WELDIT GASAVER

Saves That Useless Cost

ONE flame adjustment lasts all day. Torch is hung on hook when not in use, and no gas is burned. A pass of the torch tip over the pilot light gives you the neutral flame you had before. Savings as high as 40% have been reported. It's a safety device, too. An automatic check valve keeps flash-backs from reaching hose or regulators. The Gasaver can be used with any type of apparatus.

Approved by
National Board of Underwriters
Licensed Under Basic Patents

WELDIT

Welding Torches
Cutting Torches
Regulators
Lead Burning Equipment
Welding Wire
Welding Goggles
Cast Iron Rods
Welding Hose
Brazing Wire
Fluxes & Solders
Safety Gloves
Service

WELDIT ACETYLENE CO.
634 Bagley Ave. DETROIT, MICH.

Something New!

MILLER'S ALUMINUM SOLDER

Proclaimed the REAL Aluminum Solder by all who have used it.

Easy to apply. Maximum heat 350 degrees. Bonds perfectly. Does not warp or damage thin sheets or small castings. Can be quenched in water while hot without damage. Can be shaped or molded in any form desired. Will not flow; can be worked overhead.

Only tools needed, blow torch or hot iron and strong wire brush.

Samples and price furnished on application.

MILLER ALUMINUM SOLDER COMPANY
Incorporated
203 W. Broadway Louisville, Ky.

Now in full production with

"KORO"
(Patent applied for)

ELECTRODES

The improved production facilities in our new plant enable us to furnish KORO electrodes in any volume at prices which are distinctly attractive. The quality of the electrode is uniformly good, and the KORO processing and coating give it the rapid working quality which is so necessary in production work as well as repair work.

Send a trial order for some KORO wire from the new plant.

KORO CORPORATION
WAUKEGAN, ILLINOIS

A complete line of gas and electric welding wire.

MODEL "O"

has been designed to give the welder a maximum of comfort and protection embodied in the extreme lightness of weight, proper ventilation and the absolute exclusion of all outside light.

Model "O" Handshield

MODEL "O"

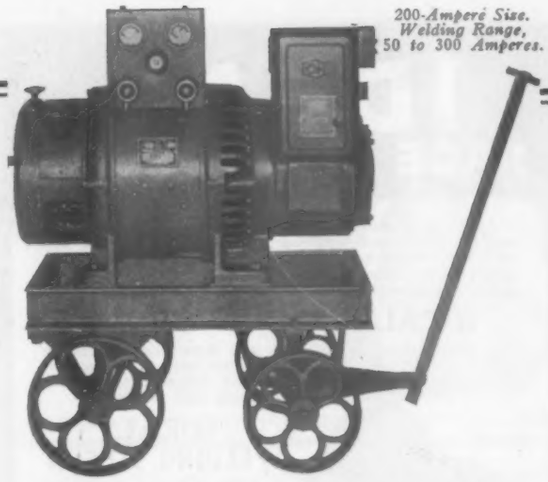
is made throughout of special vulcanized fibre of exceptional strength and wearing qualities. This shield carries the CESCO indorsement; your assurance that the degree of quality and workmanship is of the highest.

PRICE

Complete with ESSENTIALITE Lens
$5.00 *each.*

Manufactured by

Chicago Eye Shield Company
2300 Warren Ave., Chicago, Ill.



200-Ampere Size. Welding Range, 50 to 300 Amperes.

More Welds and Better Welds With the Same Time and Current

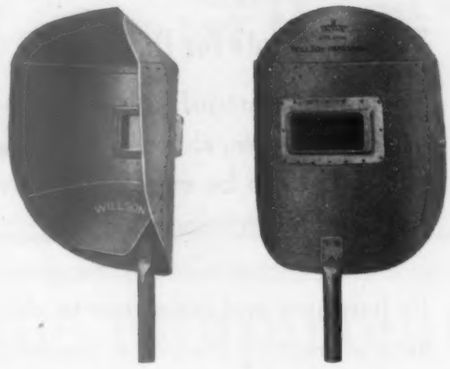
Efficiency in production welding calls for a generator which not only will deliver the most linear feet of weld with a given quantity of current, but will at the same time produce perfect welds with the greatest ease and certainty. In the

Hansen Arc Welder

these two essentials are combined so as to give the greatest welding efficiency achieved by any generator.

NORTHWESTERN MFG. CO.
Clinton and Madison Sts., Milwaukee, Wis.

The Willson Welding Handshield



Easy to handle and the last word in genuine protection. Equipped with Willson-Weld Glass, of course.

Price Complete, $7.50 each f. o. b.

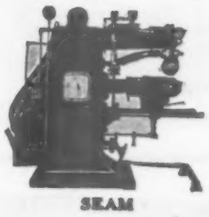
WILLSON GOGGLES, INC.
READING, PA.

LEGAL NOTICE

Our handshields and helmets are protected by patents and notice is given of prosecution of infringers.

SPOT

For Production Electric Welding Machines



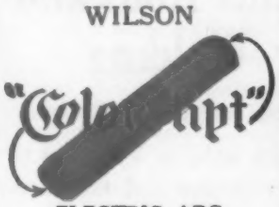
SEAM

ARC

Gibb Welding Machines Company
Bay City, Michigan
New York—Philadelphia—Cleveland—Cincinnati—Detroit—Chicago—St. Louis—Los Angeles—Toronto—Montreal

Welding Rods for Every Purpose

WILSON



ELECTRIC ARC WELDING WIRE

WILLIAMS

WELDING WIRE

ELECTRIC and GAS WELDING WIRE

High-Grade
Low-Priced
Guaranteed Analysis
Absolute Uniformity

Immediate Shipment from Warehouse

Send for samples of the new Weldflo wire

WILLIAMS & COMPANY, INC.
WELDING SUPPLIES
925-935 Pennsylvania Avenue, Pittsburgh, Penna.

"Note the name Weldflo *Each rod the same"*

Representing: TORCHWELD EQUIPMENT CO.

Have You Heard About BORIUM ?

The Substitute for Diamonds

Borium is a manufactured product of uniform size, shape and composition and can be expected to give uniform performance.

Its hardness and resistance to abrasion is next to that of a diamond. Its cost is only 1/700 that of a diamond.

Write for Further Particulars

STOODY COMPANY

Welding Rods—Alloy Steel—Equipment

WHITTIER, CALIFORNIA

IDEAL FACE SHIELDS

Ideal Face Shields protect the head, chest and neck against direct and reflected rays. Easily adjusted and removed. Constructed of vulcanized fibre and aluminum, assuring durability and lightness. Hinged door allows quick inspection of work or interchange of glasses.

IDEAL WELDING GLOVE

The Ideal Glove for Electric and Acetylene Welders is made from Sheep Skin, which has been Subjected to an Asbestos Treatment and which makes it both heat resisting and fireproof.

IDEAL WELDING APRON

The Ideal Apron for Welders is made of leather which has been especially treated to stand the heat, and at the same time be very flexible and durable.

THE IDEAL FACE SHIELD CO.

468 N. Garfield Ave.,
COLUMBUS, OHIO

Dixon's Graphite Rods and Plates for Welding

Made in all diameters, lengths and sizes.

Small diameter rods are sold in 4, 6 and 8 inch lengths, the shorter the rod the less breakage in shipping.

Also Dixon's Graphite Welding Putty. In 5 and 10 lb. cans.

Dept. 202A.

Joseph Dixon Crucible Co.

JERSEY CITY, N. J.

1827— ONE HUNDREDTH ANNIVERSARY —1927

Anti-Borax WELDING FLUX

"ANTI-BORAX"

Oxy-Acetylene Fluxes

are made for every metal and have EXCEPTIONAL merit.

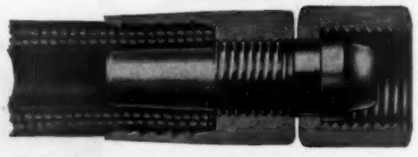
BRAZ-CAST FLUX

For bronze welding of Cast Iron.

We also make the popular "E-Z" Welding Compound for forge welding.

Samples of any upon request.

Anti-Borax Compound Co., Ft. Wayne, Ind.



NORGREN ACETYLENE HOSE COUPLING

Standard 9/16x18, right and left hand thread

LONG LIFE AND SAFETY

List Price All Sizes, $1.00

Write for literature and discounts

CARL A. NORGREN CO.

1157 CALIFORNIA ST., DENVER, COLORADO

Look at it any way you like —

SHAWINIGAN CARBIDE

gives

"More Gas per Pound"—

SHAWINIGAN PRODUCTS CORPORATION · NEW YORK · *Plants: Shawinigan Falls, Quebec · · Keokuk, Iowa · · Anniston, Ala.*

Electric Arc Welding Equipment

Transformer Arc Welders (A. C.)
Motor Generator Sets (Direct Current)
Gasoline Engine Generator Sets (D. C.)

A complete line of Electric Welding Accessories always carried on hand.
Electrodes—Holders—Masks—Handshields—Glasses—Cables, etc., etc.

ALLAN MANUFACTURING & WELDING CO., INC.
726 WASHINGTON STREET BUFFALO, NEW YORK

Sales Representatives Desired

HASKINS

Sanding down welded spots and taking out bumps in steel on automobile bodies.

Stands up under service

No matter how severe

Proved durability—that's the reputation back of HASKINS Flexible Shaft Equipments.
Best raw material available—quality parts—TIMKEN Roller-Bearings — ball-bearings — skilled workmanship — that's why HASKINS machines stand up.
Are HASKINS equipments durable? Economical? Efficient? Ask one of our many users.

Write today for full details. Free catalog on request.

R. G. Haskins Company
PORTABLE FLEXIBLE SHAFT MACHINERY
4639 W. Fulton St., CHICAGO, ILL.
BRANCH OFFICES IN PRINCIPAL CITIES

Standard size pound box, $4.50.

Crown All-Metal Filler is a mineral composition that repairs cracked waterjackets, motorheads, waterpumps, porous castings, etc., by simply heating the casting to 400° heat and rubbing on the Crown All-Metal Filler, which will penetrate through to the underside and rust up and make a guaranteed, permanent repair. Can be made to flow up, down or sideways. Being gray in color, it blends with cast iron and steel, although it can be used on all metals.

SPECIAL FOR ELECTRIC WELDERS

Crown All-Metal Filler is the only compound that will make an electric weld on cast iron absolutely watertight. It penetrates through the smallest pin-hole where it is possible for water to leak out, and the filler will rust, which is necessary for a permanent repair.

Oldest Exclusive Makers of Aluminum Solders

TRADE MARK

CROWN CROWN CROWN

Crown Aluminum Solder (hard) has been tested by the Bureau of Standards, Washington, D. C., and shown to possess tensile strength of 14,500 pounds to the square inch. Not only is Crown the strongest made, but the easiest to handle and apply, and the saving of labor makes Crown a necessity to every welder.

Crown Aluminum Solder (soft) is recommended for sheet aluminum, particularly on body work and can be applied with ordinary soldering iron. After the solder is properly applied it can't be separated from the aluminum with aid of chisel and hammer. The soft is also recommended for cracks in castings.

Crown Iron Metallic Filler is the incomparable metal for filling scored cylinders. The special Crown acid is supplied free.

WRITE TODAY FOR NEW AND LARGER DISCOUNTS ON ALL CROWN SOLDERS

Crown Aluminum Solder Co. 881 E. 134th Street New York City

After all—there is no better machine!

Cleaner welds mean better jobs and Better Jobs mean more jobs.

Biax guarantees its shaft to do your work for a year.

Write today for full information and catalogue E.

BIAX FLEXIBLE SHAFT COMPANY
20 EAST 17th STREET NEW YORK, N. Y.

FLEXIBLE SHAFT GRINDERS
TYPE M 6 - ½ H. P.

Strand
FLEXIBLE SHAFTS

We build many Types and Sizes from 1/10 to 2 H. P. Thousands in use.

Send For Our Booklet B

Manufactured By
N. A. STRAND & CO.
CHICAGO
Factory and Office
5001 - 5009 No. Lincoln St.

AGENTS WANTED
for
The Welding Engineer

A worth-while proposition to supply dealers and manufacturers' representatives

WRITE FOR DETAILS

TORIT **PREHEATING TORCHES**

Compressed Air Type or Portable Hand-Pump Type

Kerosene Preheaters save Time and Gas—produce better work!

BULLETIN ON REQUEST

ST. PAUL WELDING & MFG. CO.
170 West Third Street SAINT PAUL, MINNESOTA

ROBERT E. KINKEAD
ARC WELDING SPECIALIST
CONSULTING ENGINEER
3030 Euclid Ave. CLEVELAND, OHIO

WELDING ROD HOLDER
FOR THE OXY ACETYLENE WELDER
$1.00
ALL STEEL WIRE BRUSHES
SEND $1.00 FOR 5 ASSORTED BRUSHES
Money refunded on return of goods, if not what you want.
WRITE FOR DEALERS' PRICES
C. SORENSEN, 18 E. 16th ST., CHICAGO

$4.50

UREEKA Metallic Electrode Holder

Permits the holding of electrode with tremendous pressure, but requires only very slight pressure to release. Perfect electrical contact between electrode and holder, with elimination of current losses and overheating. For 1/16" to ¼" diameter electrodes.

GREAT STRENGTH, LIGHT WEIGHT, AMPLE CURRENT CAPACITY. NO SPRINGS.
Saves time, current, rod and worry. Try it.

$10

VULCAN Carbon Electrode Holder
for all heavy duty carbon arc welding

Positively will not overheat. Light weight. Easy to manipulate. 200, 400 and 600 ampere sizes for ½", ¾" and 1" diameter Electrode.

DISTRIBUTORS WANTED

The Fibre-Metal Products Co.
Designers and Manufacturers since 1914 of Bower's Welding Helmets and Hand Shields
CHESTER, PENNA.

COULD YOUR PROBLEM BE ANSWERED by the SPOT WELDING of DISSIMILAR METALS?

THE success of the use of Elkonite Welding Electrodes in spot welding dissimilar metals and alloys has brought it to the attention of welding engineers the country over.

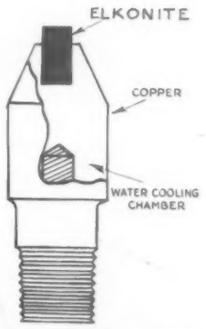


Fig. 1. Water cooled spot welding electrode showing Elkonite Insert. (Courtesy General Electric Co.)

The variable electrical and heat resistance of the different grades of Elkonite Welding Electrodes, plus their ability to hold their shape without mushrooming under red heat, heavy pressures and high currents are properties of immense value.

For this variable, relatively high resistance Elkonite as one electrode, with low resistance Elkonite or copper as the other, gives the balance necessary for even heating to welding temperature of metals of unequal heat and electrical conductivity, such as, for instance, copper with galvanized iron, or with nichrome.

METALS	ALUMINUM	ASCOLOY	BRASS	COPPER	GALVANIZED IRON	IRON	LEAD	MONEL	NICKEL	NICHROME	TIN PLATE	ZINC
ALUMINUM	•											
ASCOLOY		•		•	•	•		•	•	•	•	
BRASS			•	•	•	•		•	•	•	•	
COPPER		•	•	•	•	•		•	•	•	•	
GALVANIZED IRON		•	•	•	•	•		•	•	•	•	
IRON		•	•	•	•	•		•	•	•	•	
LEAD							•					
MONEL		•	•	•	•	•		•	•	•	•	
NICKEL		•	•	•	•	•		•	•	•	•	
NICHROME		•	•	•	•	•		•	•	•	•	
TIN PLATE		•	•	•	•	•		•	•	•	•	
ZINC												•

Fig. 2. Combinations of metals successfully welded with Elkonite. (Courtesy General Electric Co.)

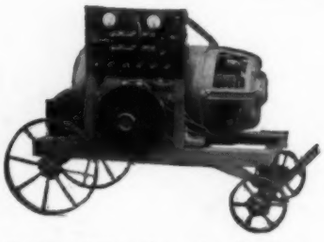
This is but one phase of the contribution that Elkonite has made to resistance welding. In flash, cross-wire, projection welding, electrical upsetting of rivets, as well as in spot welding nonferrous and heavy gauge ferrous metals Elkonite, by eliminating lost time and production due to constant redressing, and shrinkage loss, is showing new economies and production possibilities in many industries.

Our engineering staff will gladly co-operate in any resistance welding problem.

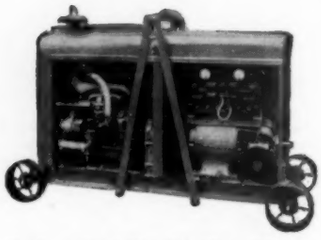
ELKON WORKS Inc.
Subsidiary of P. R. Mallory & Co. Inc.
Weehawken, N. J.

Exclusive licensees under General Electric Co. patents dated May 28, 1925 and Sept. 1, 1925. Other patents pending to Elkon Works.

ALTERNARC WELDERS



Dualarc Motor Generator Welders are finding favor in production and job shop welding because of their flexibility in meeting every welding requirement.



Dualarc Portable Gasoline Engine Driven Generator Welders are meeting the demand for arc welding where electric current is not available.

Alternarc Welders are used wherever speed in welding with economy in power consumption is important. Alternarc cutting machines are effecting great savings in foundries, steel mills and allied industries.

Welding Equipment for Every Purpose

Dualarc Gasoline Engine driven generators and motor generators are made in ratings of 200, 300, 400, and 500 amperes for manual welding. They can be equipped to provide alternating current as well as direct current. They have a separate control of amperage and voltage, giving the greatest control of welding heats—They will operate as compound wound generators delivering 40 volts to the electrode handle for carbon arc welding and for extra penetration, also taking care of line drop when long welding leads are used, and in addition will operate efficiently the more standard differential way for the 20-volt metallic arc on shopwork. Dualarc Welders have many features indorsed by leading welders throughout the country.

Alternarc Welders are made with ratings of 100, 200, 300, 400, and 500 amperes for manual welding. Speed in welding—economy in operation and maintenance are among the many reasons why over 5000 users indorse them.

Alternarc arc cutting machines are being widely used for cutting non-ferrous metals and alloy steels. This is a new development that is receiving a good reception from foundries and allied industries.

The manufacture of welding equipment has been our only business for ten years and we are in a position to supply information on welding for every purpose.

Write for our new Alternarc and Dualarc Folders, just off the press

Use Newarc Accessories

Use Newarc A flux electrodes for welding steel. Use Newarc B flux coated electrodes for cast iron. Use Newarc alloy electrodes for alloy steel welding. Use Newarc Helmets and Electrode holders for good welding. Use Newarc Fire Resistant clothing for protection when welding.

We carry supplies of Newarc accessories in stock and can ship on short notice.

There are a few desirable territories open for representation. Write or Wire Detroit office.

Electric Arc Cutting & Welding Company

Factory
152-156 Jelliff Avenue
NEWARK, NEW JERSEY

Sales Office
1202-1208 Maccabee Building
DETROIT, MICHIGAN

DUALARC WELDERS